Vernier

CATALOG
2013

Data-Collection Technology

Chemistry, Physics, Biology, STEM, Biotechnology, Engineering, Math, K–8, Physical Science, Physiology, Environmental Science, Water Quality, Earth Science

Vernier

MEASURE. ANALYZE. LEARN.™

HALL OF FAME
OREGON BUSINESS AWARD

2012 HEALTHIEST EMPLOYERS
5TH PLACE

PLACED 16TH OF 100
BEST GREEN COMPANIES
IN OREGON

PLACED 7TH OF 60
TOP WORK PLACES IN
OREGON

BUSINESS JOURNAL
CORPORATE PHILANTHROPY
AWARD FOR 2011

VERNIER IS A CORPORATE
MEMBER SUPPORTING STEM
EDUCATION IN THE U.S.

VERNIER IS PROUD TO BE RECOGNIZED FOR ITS PHILANTHROPIC COMMITMENT, ENVIRONMENTAL POLICIES, STEADY GROWTH, AND AS ONE OF THE BEST 100 COMPANIES TO WORK FOR IN OREGON FOR 13 YEARS IN A ROW.

LabQuest® 2 and the Connected Science System®

Data Sharing Gives Educators Maximum Versatility

The theme of the year for Vernier has been "Connectivity." In March of 2012, we announced our most advanced interface ever, LabQuest 2. LabQuest 2 includes built-in Wi-Fi, which has opened the door to some amazing new possibilities—a group of products we call the Connected Science System.

The Wi-Fi capability of LabQuest 2 led to the development of the Vernier Data Share web app, which can be used on the browsers of mobile devices and on computers to view and analyze data that has been wirelessly sent from LabQuest 2. The Wi-Fi feature also led to an iPad version of Graphical Analysis,™ an app for graphing both sensor-based data and data entered manually. Educators tell us they love the connectivity feature of LabQuest 2, because it allows them to collect and analyze data with whichever tablet or mobile device their schools may use in the future.

So that our customers with earlier interfaces would not feel left out, we added Vernier Data Sharing to the new version of Logger *Pro*. Even if you have ten-year-old interfaces, you can still wirelessly send data to students who are using mobile devices and computers!

This year, we also introduced some interesting new sensors: the Ethanol Sensor, Goniometer, Pyranometer, and Vernier Optical DO Probe, as well as an improved version of our Mini Gas Chromatograph and a less-expensive Radiation Monitor.

If you plan to travel to Portland this year for AAPT in July or for NSTA in October, we hope you stop by our office for a tour. As always, we encourage you to give our products a try on a 30-day (or longer) preview basis. Feel free to contact either of us personally at any time.

Dave and Christine Vernier
dvernier@vernier.com and cvernier@vernier.com

VERNIER SOFTWARE & TECHNOLOGY

Vernier Software & Technology was co-founded in 1981 by Dave and Christine Vernier. Dave's background as a physics teacher and Christine's knack for business combined to form a company with a deep commitment to education.

Thirty-two years later, the company is still owned by Christine and Dave, along with 11 employee owners who have backgrounds in science and math education, as well as business.

Performing an acid-base titration

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What's NEW

LabQuest® 2

Designed for science and STEM education, our new LabQuest 2 is powerful, connected, and versatile. Your students will love the high-resolution screen, wireless connectivity, and robust data-collection capabilities. It's the perfect solution for classroom laboratory experiments, and the new built-in GPS sensor makes it ideal for field work, as well.

PP. **5–11** Read the reviews at **www.vernier.com/labquest**

NEW DATA SHARING FOR LOGGER *PRO* PAGE **13**

CONNECTED SCIENCE SYSTEM® PAGE **12**

APPS FOR iOS PAGE **22**

Graphical Analysis™ for iPad® – Now you can view and analyze data with this native iOS app.

Video Physics – Perform video analysis on the iPad, iPhone, and iPod touch.

NEW **Available Spring 2013**

Vernier Optical DO Probe

Students can now measure the concentration of dissolved oxygen in water quickly and easily with the new Vernier Optical DO Probe. This plug-and-play probe requires no calibration, filling solution, warm-up time, or stirring.

PAGE **35**

NEW Ethanol Sensor

Use our Ethanol Sensor to measure the concentration of ethanol in air above an aqueous sample. Students can determine the rate of ethanol production during fermentation or measure the discrete amount of ethanol in a given sample.

PAGE **34**

NEW Goniometer

Our new Goniometer measures the angle of a joint, such as the elbow or knee. Use it to analyze the range of motion of a limb during different types of physical activity. It can also be used in a variety of STEM and engineering activities.

PAGE **127**

NEW Pyranometer

Now your students can conduct solar-cell experiments using our new Pyranometer, which measures the power of electromagnetic radiation in watts per square meter. It is sensitive to near infrared, visible, and UV radiation, where 90% of solar energy is concentrated.

PAGE **66**

NEW FEATURES
Vernier Mini GC Plus

The new features on our gas chromatograph allow you to analyze more compounds than ever before. Your students can use this portable instrument for separating, analyzing, and identifying substances contained in a volatile liquid or gaseous sample. It's the perfect solution for your organic chemistry labs.

PAGE **46**

NEW TI-84 Plus C Silver Edition

Texas Instruments introduces the next generation of the popular TI-84 Plus family of graphing calculators, which feature full-color display. The TI-84 C has the same menu structure, navigation, and applications, making the transition from a TI-83/84 seamless.

PAGE **115**

NEW Vernier Radiation Monitor

Detect alpha, beta, gamma, and X-ray radiation using the Vernier Radiation Monitor. Applications include nuclear counting statistics, shielding, and decay rate measurements.

PAGE **87**

NEW Time of Flight Pad

Use the Time of Flight Pad to precisely measure how long a projectile has been in motion. Designed for use with the Vernier Projectile Launcher and a Vernier interface.

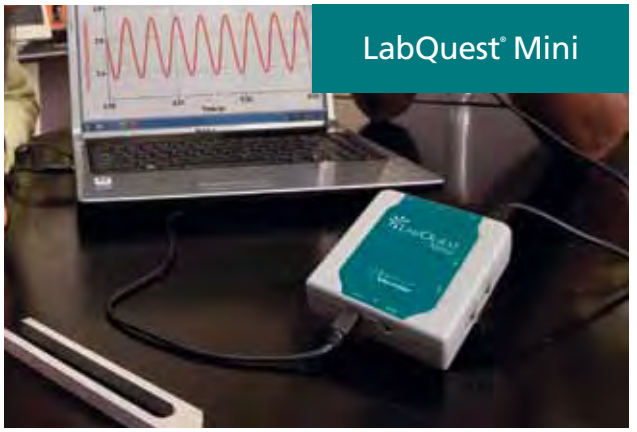
PAGE **93**

NEW Independence of Motion Accessory

Now your students can perform a classic experiment using the Vernier Projectile Launcher and our new Independence of Motion Accessory: drop one ball as another is projected horizontally and watch (or hear) as the balls strike the floor simultaneously.

PAGE **93**

INTERFACE CHOICES



INTERFACES—COMPATIBILITY / PRICE CHART

CHOICES		SUPPORTED PLATFORMS	MAXIMUM SAMPLING RATE	COMPATIBLE VERNIER SENSORS	REMOTE DATA COLLECTION	BUILT-IN COLOR SCREEN	RECHARGEABLE BATTERY	BUILT-IN SENSORS	SUPPORTS MULTIPLE SENSORS	SOFTWARE	STANDARDS-BASED LABS
LabQuest® 2 $329 ORDER CODE **LABQ2** See pp. 5–11		Standalone or Computers	100,000 per second	78 sensors See page 10 for a compatible sensor list	Built in	Yes	Yes	Temperature Microphone GPS Accelerometers Light	Yes	Built-in LabQuest and other applications See pp. 7–9 Logger Lite (free download) Logger *Pro* (sold separately) See pp. 18–21	100 included labs 300+ more available on web site 400+ labs available in print See page 106
LabQuest® Mini $149 ORDER CODE **LQ-MINI** See pp. 14–15		Computers	100,000 per second	68* sensors See page 15 for a compatible sensor list	With a laptop computer	No	No batteries needed (USB powered)	None	Yes	Logger Lite (free download) Logger *Pro* (sold separately) See pp. 18–21	300+ more available on web site 400+ labs available in print
Go!Link® $61 ORDER CODE **GO-LINK** See page 16		Computers	200 per second	54* sensors See page 16 for a compatible sensor list	With a laptop computer	No	No batteries needed (USB powered)	None	No	Logger Lite (included) Logger *Pro* (sold separately) See pp. 18–21	300+ more available on web site 400+ labs available in print

* Count does not include 14 USB or Bluetooth® sensors that connect directly to the computer but can be used in a computer-based lab station.

FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 110–117

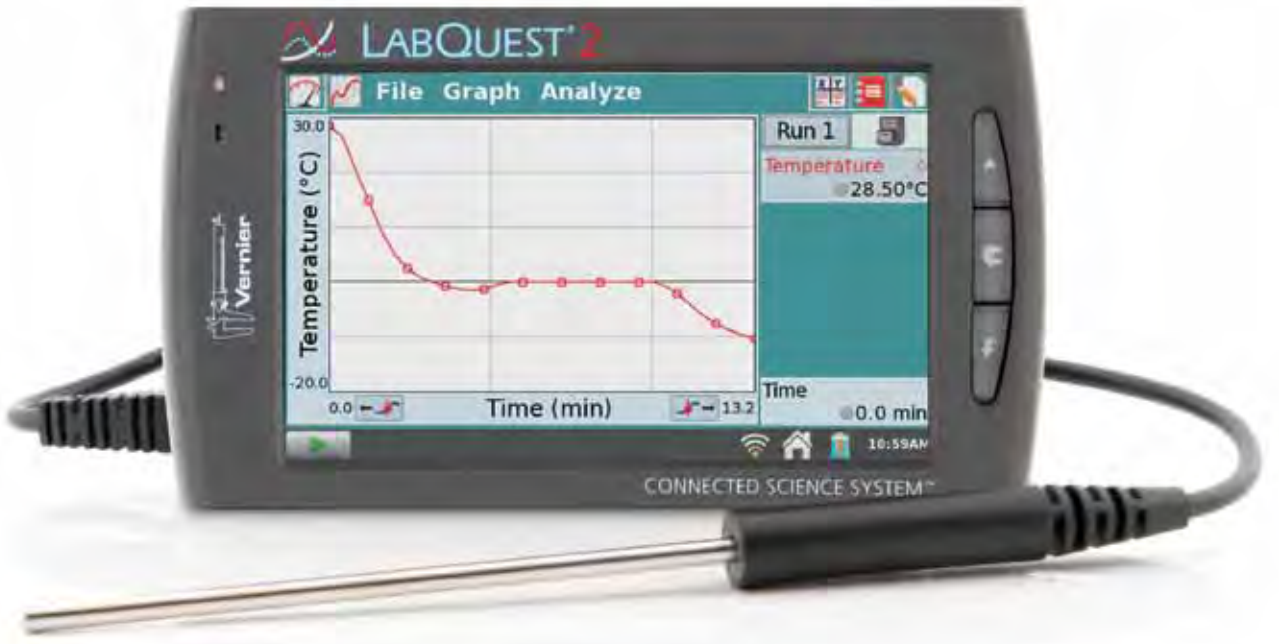
Meet LabQuest® 2

The most powerful, connected, and versatile data-collection device available for STEM education

AWARD-WINNING TECHNOLOGY

Worlddidac Award granted to both LabQuest 2 and the Connected Science System

Readers' Choice Award from eSchool Media awarded to LabQuest 2



READ THE REVIEWS

Tech & Learning – "Vernier's LabQuest 2 can build interest in science, make experiments come alive, and deepen understanding of complex concepts. The affordable handheld tool supports student-centered, inquiry-based learning...and critical analysis as budding scientists use real tools to conduct real-time investigations... ." – Carol S. Holzberg, Ph.D.

Assistive Technology – "With the LabQuest 2, Vernier has transformed the way teachers need to think about teaching science in the classroom and provided them with an easy and powerful solution for capturing data in real time." – Brian Friedlander, Ph.D.

Scholastic Administrator's Tech Tools – Grade: A, "A bargain. LabQuest is a modern-day science lab that fits in the palm of a hand." – Brian Nadel

NSTA Blog – "It seemed obvious that the LabQuest 2 would be a real game changer in the data-collection space, but after our field test, it seems more that the LabQuest 2 has invented an entirely new game." – Martin Horejsi

Read the full reviews of LabQuest 2 and the Connected Science System at **www.vernier.com/labquest**

LABQUEST® 2
CONNECTED SCIENCE SYSTEM®

$329
ORDER CODE
LABQ2

Meet LabQuest 2

The most powerful, connected, and versatile interface ever

Presenting the most powerful interface for science education. Engage your students with hands-on science in your classroom or in the field.

Use it as a standalone device or as a computer interface with our award-winning Logger *Pro* or Logger Lite software. Created with today's classroom in mind, you will love its high-resolution screen, responsiveness, and ease of use. And, of course, because it was developed by Vernier, it is backed by comprehensive curricula, a generous warranty, and legendary support.

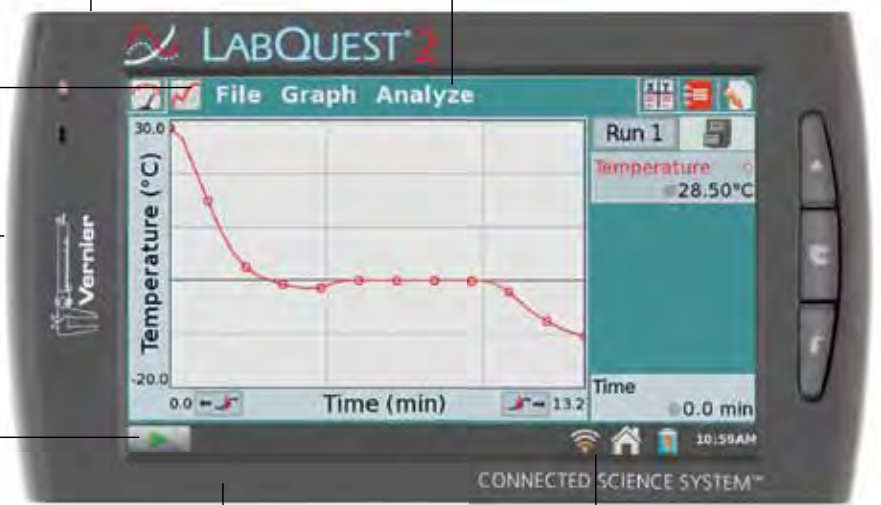
Full sensor support
Compatible with all Vernier sensors

Faster analysis
Quick response to touch, curve fits, and modeling

High-resolution touch screen
- 12.8 cm, 800 x 480 pixel resolution
- Designed for both stylus and touch
- Wide viewing angle for lab groups

Built-in sensors
- GPS
- 3-axis accelerometer
- Ambient temperature
- Light
- Microphone

Fast data collection
100,000 samples per second



Rechargeable batteries
High capacity, lithium-ion rechargeable battery

Wireless connectivity
- Wi-Fi
- Bluetooth

Included with LabQuest 2: LabQuest 2 unit, rechargeable battery, USB cable, power adapter, stylus, stylus tether

USB port for USB sensors, flash drive, or other USB peripherals.

Two digital sensor ports for use with motion detectors, photogates, drop counters, and more.

Three analog sensor ports for use with 60 compatible sensors such as temperature, pH, and CO_2 sensors.

Power port – Use with AC or recharge LabQuest's built-in battery.

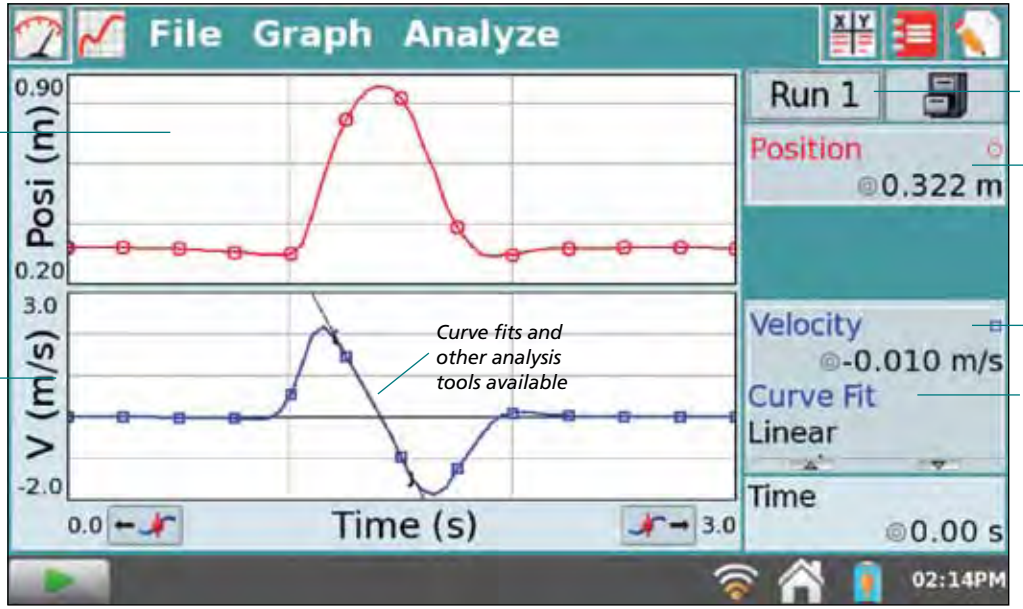
Micro SD/MMC card slot

Computer Connectivity
Connect your LabQuest to a Windows or Macintosh computer to collect data using Logger *Pro* or Logger Lite.

Audio in (left)
Audio out (right)
Connect speakers, microphone, power amplifier, or headphones.

TECHNICAL SPECIFICATIONS

Screen Size: 11.2 cm × 6.7 cm
Screen Resolution: 800 x 480 color display
Weight: 350 g
CPU: 800 MHz application processor
Battery: Lithium-ion rechargeable battery; carries a one-year warranty



Quick access to graphs, tables, and meters

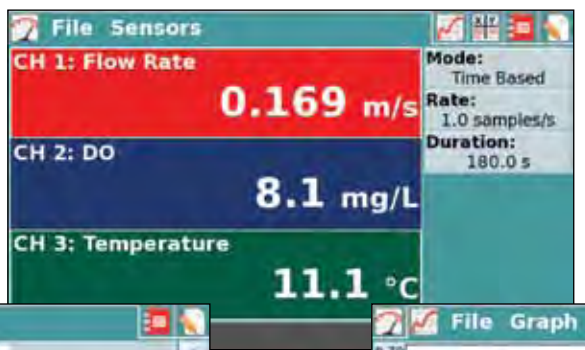
One or two high-resolution plots of data are displayed in real time.

Curve fits and other analysis tools available

Multiple runs can easily be stored and recalled later.

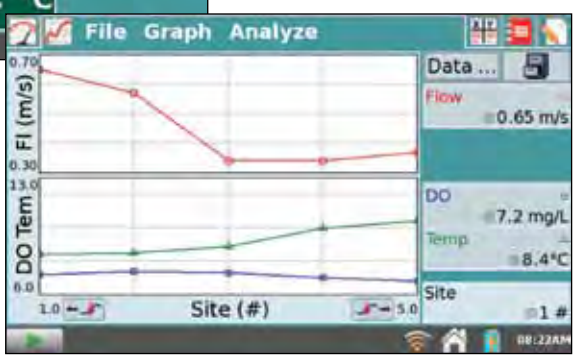
Live display of sensor data

Curve fit statistics are displayed.



Meter

Data table



Graph

Built-In Software

ANALYSIS FEATURES

- Perform linear and curve fits
- Landscape and portrait views
- Supports built-in sensors—GPS, microphone, accelerometers, relative light sensor, temperature
- Draw a prediction before collecting data
- Display two graphs at once
- Display a tangent line on the graph
- Integral function
- Statistics

BUILT-IN APPLICATIONS

- Stopwatch
- Periodic table
- Scientific calculator
- Audio function generator
- Power amplifier (requires Vernier Power Amplifier)

OTHER GREAT FEATURES

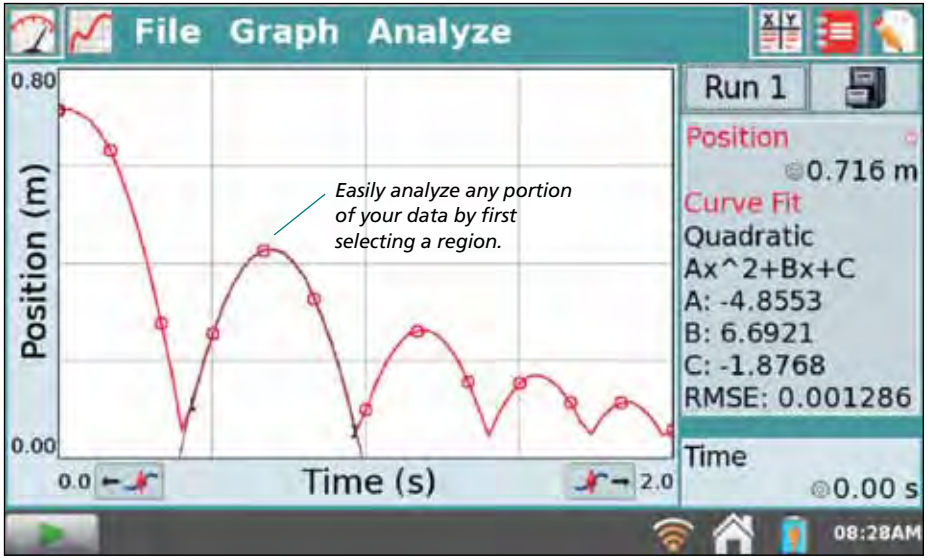
- Export data to Logger *Pro*
- View with our Logger Lite (free download from our website)
- More than 100 preloaded lab instructions from Vernier's popular lab books
- Notes field
- Voice annotation with internal microphone
- Find slopes, fit a line to a portion of your data, and display position data and its derivatives

One-Touch Simplicity

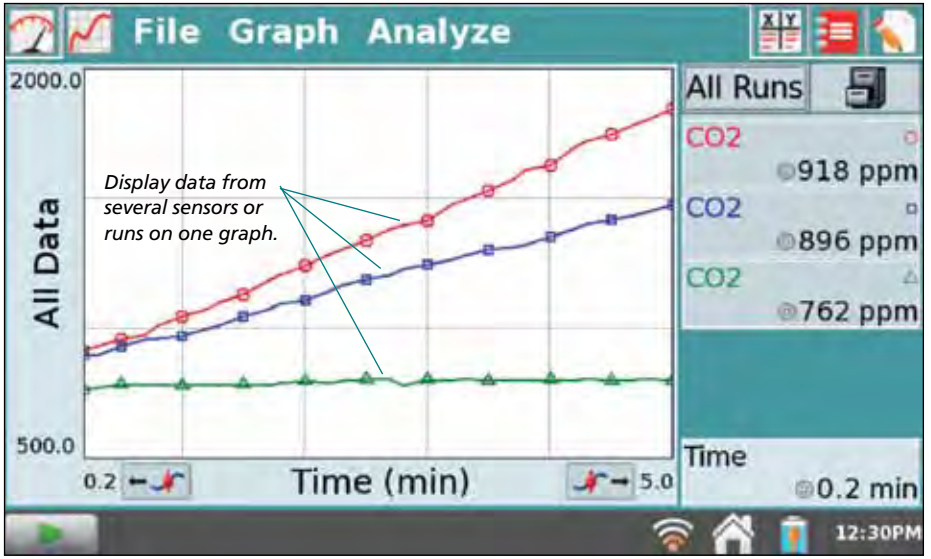
The LabQuest App gives your students real-time graphing capabilities in a handheld device. It's powerful—yet beautifully simple.

Your students can collect data and view them in a **Data Table, Meter,** or **Graph View.**

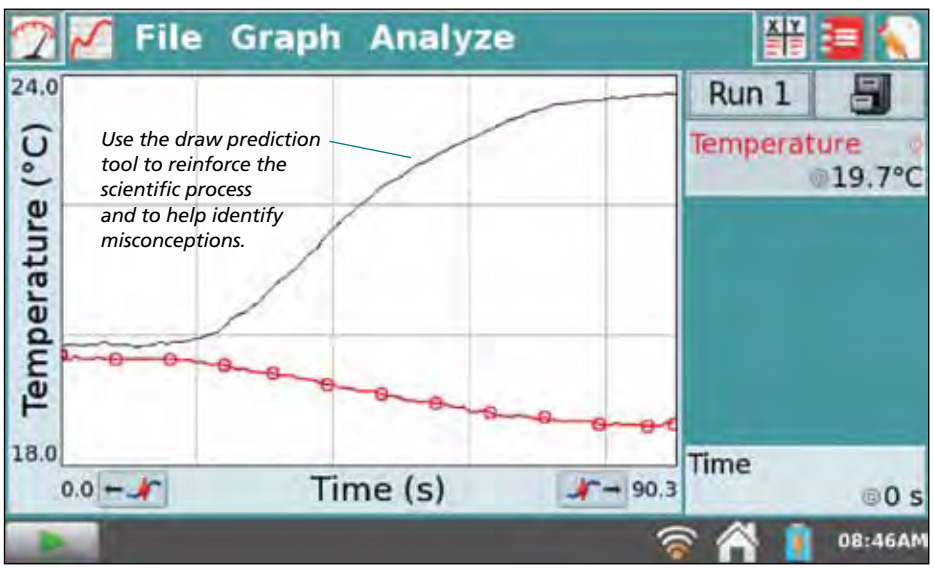
Data analysis at your fingertips



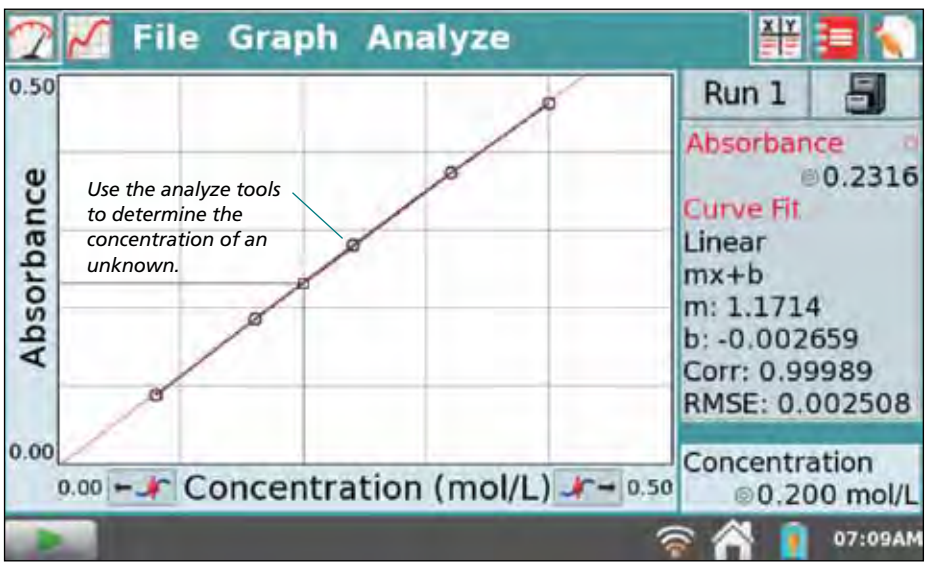
Position vs. time graph of a bouncing ball



Investigating the rate of cellular respiration at different temperatures

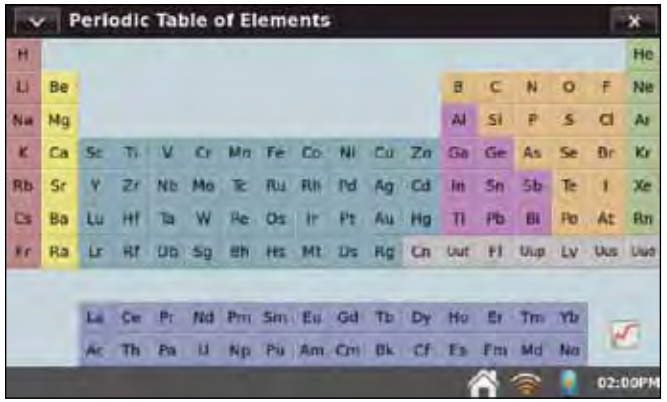


Temperature vs. time graph as an Alka-Seltzer® tablet dissolves in water

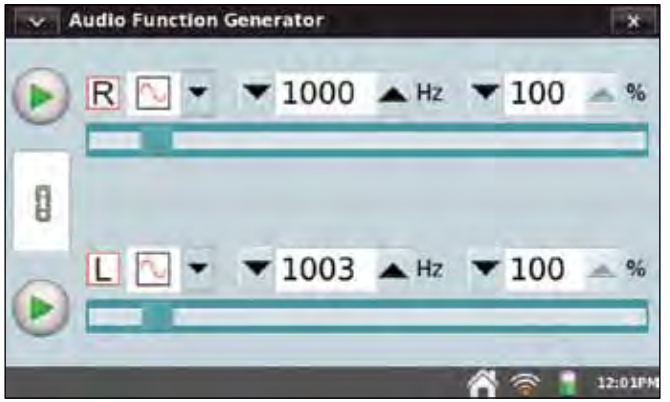


Beer's law analysis of nickel (II) sulfate solution

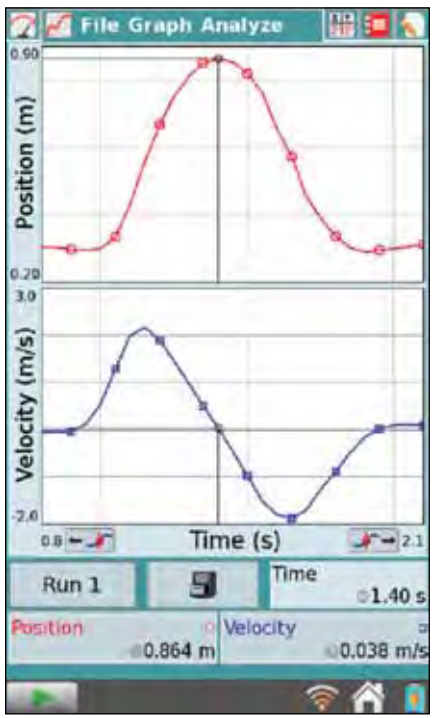
Additional applications and features



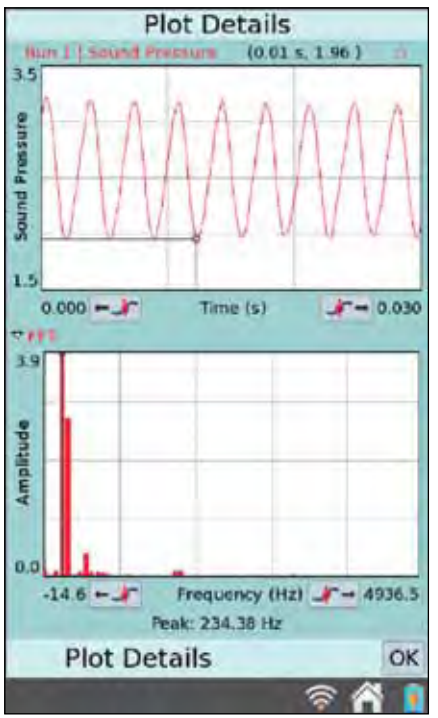
On-board Periodic Table Application



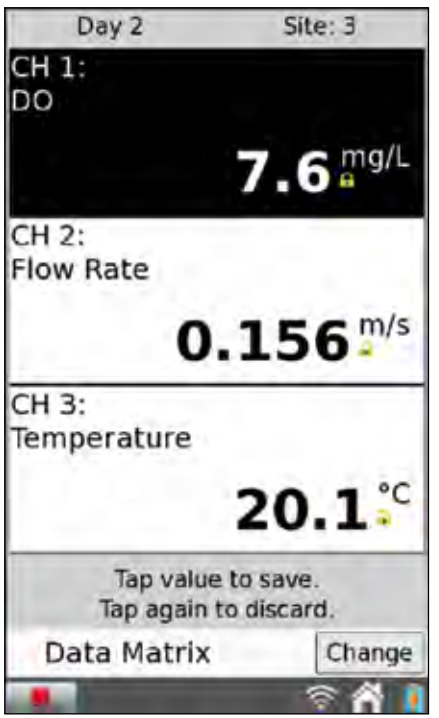
Audio Function Generator



Rotate your LabQuest 2 to view two graphs in portrait view.



Advanced analysis features include FFT analysis.



High-contrast screen setting makes it easier to see your data in bright light.

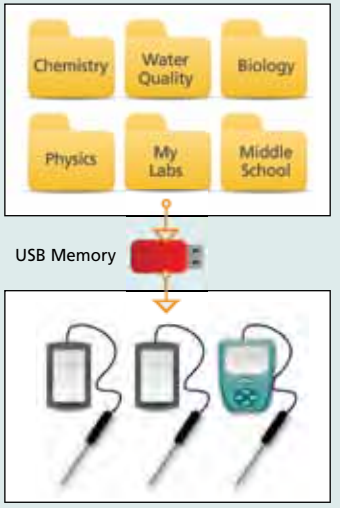
MY LABQUEST LIBRARY

My LabQuest Library allows you to create, customize, organize, and download labs to LabQuest for the entire class.
www.vernier.com/mylabquest

LAB CREATOR | LAB ORGANIZER

Create your own labs with the Lab Creator
Use this **FREE** custom application to create and easily upload your labs to LabQuest.

Customize your LabQuest with the Lab Organizer
More than 400 Vernier experiments from 16 lab books are available to upload to your LabQuest.

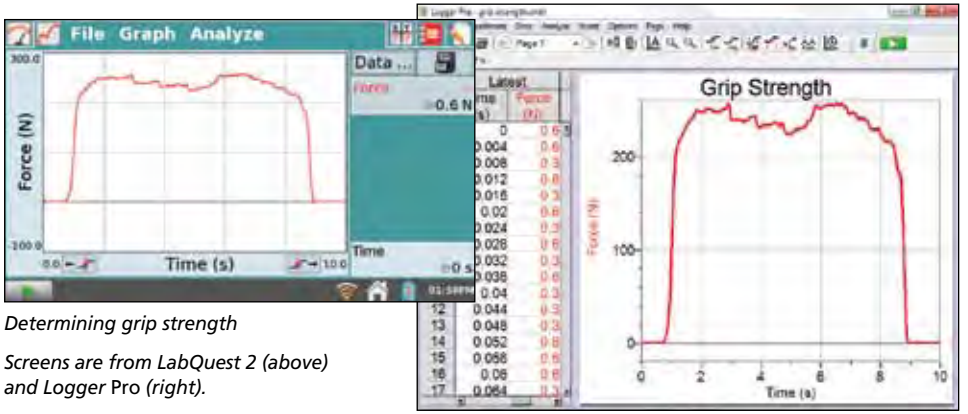


Did you know?

You can have a mixed classroom of LabQuest 2 and original LabQuest units without having to give separate lab instructions for each. We designed the LabQuest 2 to support side-by-side use with the original LabQuest. See page 106.

Easily download your data from LabQuest to a computer for further analysis with Logger *Pro* Software

For more information about Logger *Pro*, see pp. 18–21.



Determining grip strength

Screens are from LabQuest 2 (above) and Logger Pro *(right).*

LABQUEST 2 COMPATIBLE SENSORS

SENSOR	CODE	PRICE
Accelerometers		
3-Axis Accelerometer	3D-BTA	$99
25-g Accelerometer	ACC-BTA	$92
Low-g Accelerometer	LGA-BTA	$89
Anemometer	ANM-BTA	$89
Barometer	BAR-BTA	$71
Blood Pressure Sensor	BPS-BTA	$105
Charge Sensor	CRG-BTA	$75
CO_2 Gas Sensor	CO2-BTA	$249
Colorimeter	COL-BTA	$115
Conductivity Probe	CON-BTA	$95
Constant Current System	CCS-BTA	$59
Current Probes		
Current Probe	DCP-BTA	$39
High Current Sensor	HCS-BTA	$79
Diffraction Apparatus	DAK	$549
Digital Control Unit	DCU-BTD	$61
Dissolved Oxygen Probes		
Dissolved Oxygen Probe	DO-BTA	$209
NEW Vernier Optical DO Probe	ODO-BTA	$379
Drop Counter	VDC-BTD	$99
Dual-Range Force Sensor	DFS-BTA	$109
EKG Sensor	EKG-BTA	$147
Electrode Amplifier	EA-BTA	$40
NEW Ethanol Sensor	ETH-BTA	$109
Flow Rate Sensor	FLO-BTA	$129
Force Plate	FP-BTA	$225
Gas Pressure Sensor	GPS-BTA	$83
NEW Goniometer	GNM-BTA	$159
Hand Dynamometer	HD-BTA	$99

SENSOR	CODE	PRICE
Hand-Grip Heart Rate Monitor	HGH-BTA	$119
Instrumentation Amplifier	INA-BTA	$59
Ion-Selective Electrodes		
Ammonium Ion-Selective Electrode	NH4-BTA	$179
Calcium Ion-Selective Electrode	CA-BTA	$179
Chloride Ion-Selective Electrode	CL-BTA	$179
Nitrate Ion-Selective Electrode	NO3-BTA	$179
Light Sensor	LS-BTA	$55
Magnetic Field Sensor	MG-BTA	$58
Melt Station	MLT-BTA	$449
Microphone	MCA-BTA	$39
Mini GC Plus	GC2-MINI	$1,799
Motion Detectors		
Go!Motion Motion Detector	GO-MOT	$109
Motion Detector	MD-BTD	$79
O_2 Gas Sensor	O2-BTA	$188
ORP Sensor	ORP-BTA	$79
pH Sensor	PH-BTA	$79
pH Sensor, Tris-Compatible Flat	FPH-BTA	$99
Photogate	VPG-BTD	$45
Polarimeter (Chemical)	CHEM-POL	$499
Power Amplifier	PAMP	$199
Projectile Launcher	VPL	$299
NEW Pyranometer	PYR-BTA	$199
Radiation Monitors		
NEW Vernier Radiation Monitor	VRM-BTD	$169
Radiation Monitor *(Digital)*	DRM-BTD	$299
Relative Humidity Sensor	RH-BTA	$69
Respiration Monitor Belt *(requires GPS-BTA)*	RMB	$63
Rotary Motion Sensor	RMV-BTD	$169

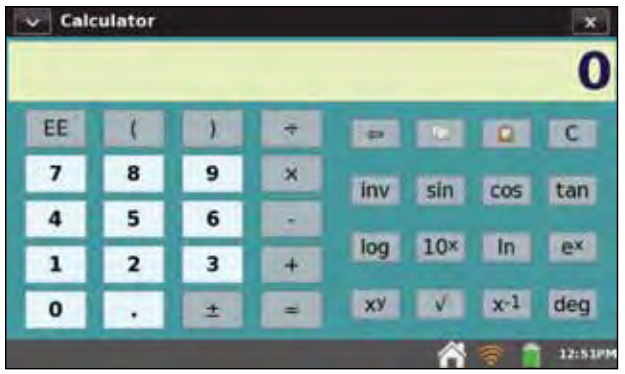
SENSOR	CODE	PRICE
Salinity Sensor	SAL-BTA	$92
Soil Moisture Sensor	SMS-BTA	$95
Sound Level Meter	SLM-BTA	$165
Spectrometers		
SpectroVis Plus	SVIS-PL	$459
Ocean Optics Spectrometers		
Vernier Spectrometer	V-SPEC	$1,299
Red Tide Spectrometer	SPRT-VIS	$1,732
Red Tide UV-VIS Spectrometer	SPRT-UV-VIS	$2,987
Red Tide Emissions Spectrometer	ESRT-VIS	$1,154
Spirometer	SPR-BTA	$199
Temperature Probes		
Extra-Long Temperature Probe	TPL-BTA	$79
Go!Temp Temperature Probe	GO-TEMP	$39
Infrared Thermometer	IRT-BTA	$169
Stainless Steel Temperature Probe	TMP-BTA	$29
Surface Temperature Sensor	STS-BTA	$23
Thermocouple	TCA-BTA	$69
Wide-Range Temperature Probe	WRT-BTA	$79
Turbidity Sensor	TRB-BTA	$112
UVA Sensor	UVA-BTA	$106
UVB Sensor	UVB-BTA	$107
Voltage Probes		
Differential Voltage Probe	DVP-BTA	$39
Voltage Probe	VP-BTA	$12
30-Volt Voltage Probe	30V-BTA	$49
Watts Up Pro	WU-PRO	$145
Wireless Dynamics Sensor System	WDSS	$249

For more information about sensors, see pp. 118–141

Did you know?

The original LabQuest and LabQuest 2 can print directly to most HP printers. Simply connect LabQuest to the printer with a standard USB cable. You can also use Wi-Fi connectivity to connect to printers on your school network or directly to Wi-Fi enabled printers.

Built-in Stopwatch



On-board Scientific Calculator

a. LabQuest Viewer, ORDER CODE LQ-VIEW, $49

Teach students how to use LabQuest by projecting your LabQuest screen via Wi-Fi. Remotely monitor student progress by viewing student LabQuests.

- Use built-in Wi-Fi on LabQuest 2
- Use Wi-Fi dongle for the original LabQuest
- Compatible with both Mac and PC

Includes a site license for every teacher's computer in your school or college department.

b. LabQuest 2 Lab Armor, ORDER CODE LQ2-ARMOR, $15

Add extra protection from spills and falls with Lab Armor for LabQuest 2. Molded rubber material helps prevent spills from getting into open ports. Note: Lab Armor must be removed when charging via the Charging Station.

c. LabQuest Lanyard, ORDER CODE LQ-LAN, $5

This lanyard connects to the back of your LabQuest, so you don't have to worry about students dropping their interface during field studies.

d. LabQuest 2 Charging Station, ORDER CODE LQ2-CRG, $109

Multi-bay charging capability for your LabQuest.

Want a way to charge and store your LabQuest 2 units? The LabQuest 2 Charging Station is the perfect solution. Each charging station has four charging slots. LEDs on the charging station indicate the charging status.

Note: If you have original LabQuests, see page 142.

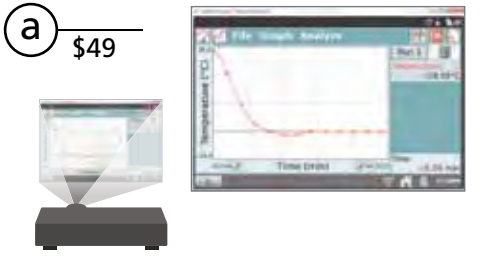
e. LabQuest Battery Boost 2, ORDER CODE LQ-BOOST2, $109

The Battery Boost 2 is a rechargeable external battery for your original LabQuest or LabQuest 2. Data can be collected for extended periods in the field where AC power is not available.

f. LabQuest Stand, ORDER CODE LQ2-STN, $5

Use this stand to set LabQuest 2 at an angle for easier viewing. The stand can also reduce the possibility of damage due to spills by raising LabQuest 2 off of the lab bench.

a $49



b $15

c $5

d $109

e $109

f $5

LABQUEST® 2
CONNECTED SCIENCE SYSTEM®

Connected Science System®

The Connected Science System is a collection of products that supports hands-on, collaborative learning with individualized accountability. The wireless capabilities of LabQuest 2 provide unprecedented tools for viewing, collecting, and analyzing experimental data using computers and mobile devices such as iPad®.

To learn more or to view tutorial videos, go to **www.vernier.com/css**

worlddidac AWARD 2012

Note: Connected Science System features are supported via Wi-Fi and may require network configuration. See our web site for requirements and implementation examples.

LABQUEST VIEWER™

LabQuest Viewer software allows you to wirelessly view and control LabQuest from your Windows or Mac computer. When used with a projector, you can display any LabQuest screen for the entire class. Share the instructor LabQuest screen for demos or students' LabQuests for class presentations.

Use LabQuest Viewer in the classroom to:

- View and control one or more LabQuest interfaces from a computer.
- Use with a projector or interactive whiteboard for class demos or sharing.
- Monitor student progress.
- Create LabQuest screenshots and paste the images into lab instructions.
- Set customizable permissions to restrict remote control, filter devices by channel, or to enable password protection of the connection.
- Install LabQuest Viewer on any computer in your school or college department with the included site license.

Support for LabQuest Viewer is built into LabQuest 2 and can also be added to an original LabQuest interface with the purchase of a Wi-Fi USB adapter. See page 142.

ORDER CODE **LQ-VIEW, $49** **www.vernier.com/lq-view**

VERNIER DATA SHARE™ WEB APP

Data collection and analysis with the versatility of modern web technology

Students use Vernier Data Share and mobile devices with compatible browsers to wirelessly collect LabQuest 2 and Logger *Pro* data from sensors. Lab group members collaboratively collect data from an experiment, and each student analyzes a copy of the data on an individual device. Students use analysis tools in class or at home and print graphs or save data for lab reports and further analysis.

Vernier Data Share is included with LabQuest 2 and Logger *Pro*.

www.vernier.com/data-share

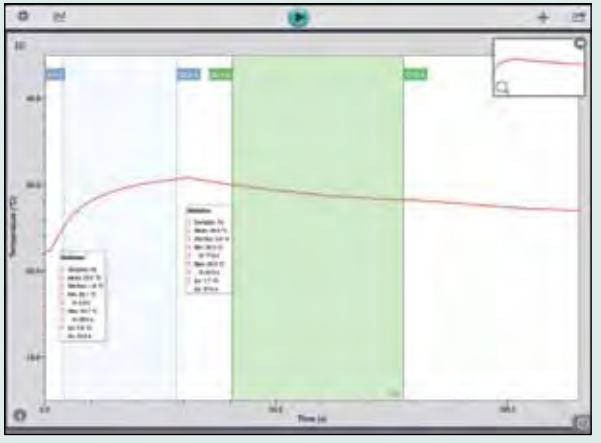
Vernier Data Share

Versatility – Any device with a network connection and a compatible browser can collect, graph, analyze, and save data. Vernier Data Share supports iPad, iPhone®, iPod® touch, Android phones and tablets, Chromebooks, notebook computers, and more.

Advanced Features of Data Sharing Apps

1-to-1 Learning – Each member of a lab group can access data collected from a single Data Sharing source, such as LabQuest 2 or Logger *Pro*. Lab groups cooperate on an experiment, and each student receives an individual copy of the data for analysis. Students can individually annotate the data, perform curve fits, and make statistical calculations.

Every member of the lab group can take advantage of a fluid, intuitive, and personal experience.



Use Graphical Analysis for iPad to wirelessly collect, analyze, annotate, save, and send sensor data.

iPad, iPhone, and iPod touch are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

GRAPHICAL ANALYSIS™ for iPad®

Data collection and analysis with the power of iPad

Students use the Graphical Analysis app to wirelessly collect LabQuest 2 or Logger *Pro* sensor data and manipulate and share analysis using the multi-touch iPad interface for a fluid, intuitive, and personal experience.

Each student analyzes a copy of the data on an individual iPad. The app automatically saves progress so students can view and analyze data after class or at home. Students can export data to Logger *Pro* and other software for additional analysis and lab reports.

Graphical Analysis for iPad can also graph manually entered data, with access to the same analysis and annotation tools used for sensor-based data collection.

www.vernier.com/ga-ipad

Graphical Analysis

Power of iPad – Graphical Analysis automatically identifies LabQuest and Logger *Pro* Data Sharing sources on the network, and students connect with a single tap. Learners tap, drag, pinch, and stretch to examine and analyze graphs in an immersive multi-touch environment.

Each experiment is automatically saved within the app. Students can create a lab report or submit data to the teacher via email, camera roll, print function, and even third-party apps.

Available on the App Store

"...I'd even go so far as to say that human imagination is the main limit of Vernier's Connected Science System right now."

– Martin Horejsi, NSTA blog

LabQuest MINI

$149
ORDER CODE
LQ-MINI

Affordable. Powerful. Easy to Use.

LabQuest Mini brings the power of Vernier's award-winning LabQuest technology to teachers who don't need the versatility of a standalone device. The perfect solution for educators collecting data with a computer, LabQuest Mini interfaces with Logger Lite and Logger *Pro* software for unparalleled power, analysis, and curricular support.

Key features include:

- 100 kHz maximum sampling rate gives you the unrivaled power of LabQuest
- Five sensor ports give you the flexibility to choose from 68 compatible sensors.

"Excellent product that will serve many classroom environments well."
– Tech & Learning

FIVE TOTAL SENSOR PORTS

Three Analog Sensor Ports
For use with 60 compatible sensors, such as temperature, pH, and force.

Two Digital Sensor Ports
For use with digital sensors, such as motion detectors, photogates, chemical polarimeters, diffraction apparatus, and drop counters.

COLLECTING DATA EXCLUSIVELY ON COMPUTERS?

LabQuest Mini may be perfect for you!

- You can download our FREE Logger Lite software from our web site to get your students quickly collecting and analyzing data.
- Looking for more advanced features than Logger Lite provides? Our award-winning Logger *Pro* 3 software provides advanced analytical features including video analysis. See pp. 18–21 for additional details.
- Use with over 20 Vernier lab books covering core topics in Biology, Chemistry, Earth Science, Engineering, Environmental Science, Physical Science, Physics, Physiology, and Water Quality.

TECHNICAL SPECIFICATIONS

Computer Connection:
USB 2.0 Full Speed

Software Requirements:
Logger *Pro* 3.8.2 or newer
or Logger Lite 1.5 or newer

Analog Inputs: 3

Digital Inputs: 2

Sampling Rate:
100,000 samples per second

LABQUEST MINI COMPATIBLE SENSORS*

SENSOR	CODE	PRICE	SENSOR	CODE	PRICE	SENSOR	CODE	PRICE
Accelerometers			Flow Rate Sensor	FLO-BTA	$129	NEW Pyranometer	PYR-BTA	$199
3-Axis Accelerometer	3D-BTA	$99	Force Plate	FP-BTA	$225	Radiation Monitors		
25-g Accelerometer	ACC-BTA	$92	Gas Pressure Sensor	GPS-BTA	$83	NEW Vernier Radiation Monitor †	VRM-BTD	$169
Low-g Accelerometer	LGA-BTA	$89	NEW Goniometer	GNM-BTA	$159	Radiation Monitor † (Digital)	DRM-BTD	$299
Anemometer	ANM-BTA	$89	Hand Dynamometer	HD-BTA	$99	Relative Humidity Sensor	RH-BTA	$69
Barometer	BAR-BTA	$71	Hand-Grip Heart Rate Monitor	HGH-BTA	$119	Respiration Monitor Belt (requires GPS-BTA)	RMB	$63
Blood Pressure Sensor	BPS-BTA	$105	Instrumentation Amplifier	INA-BTA	$59	Rotary Motion Sensor †	RMV-BTD	$169
Charge Sensor	CRG-BTA	$75	Ion-Selective Electrodes			Salinity Sensor	SAL-BTA	$92
CO_2 Gas Sensor	CO2-BTA	$249	Ammonium Ion-Selective Electrode	NH4-BTA	$179	Soil Moisture Sensor	SMS-BTA	$95
Colorimeter	COL-BTA	$115	Calcium Ion-Selective Electrode	CA-BTA	$179	Sound Level Meter	SLM-BTA	$165
Conductivity Probe	CON-BTA	$95	Chloride Ion-Selective Electrode	CL-BTA	$179	Spirometer	SPR-BTA	$199
Constant Current System	CCS-BTA	$59	Nitrate Ion-Selective Electrode	NO3-BTA	$179	Temperature Probes		
Current Probes			Light Sensor	LS-BTA	$55	Extra-Long Temperature Probe	TPL-BTA	$79
Current Probe	DCP-BTA	$39	Magnetic Field Sensor	MG-BTA	$58	Infrared Thermometer	IRT-BTA	$169
High Current Sensor	HCS-BTA	$79	Melt Station †	MLT-BTA	$449	Stainless Steel Temperature Probe	TMP-BTA	$29
Diffraction Apparatus	DAK	$549	Microphone	MCA-BTA	$39	Surface Temperature Sensor	STS-BTA	$23
Digital Control Unit †	DCU-BTD	$61	Motion Detector	MD-BTD	$79	Thermocouple	TCA-BTA	$69
Dissolved Oxygen Probes			O_2 Gas Sensor	O2-BTA	$188	Wide-Range Temperature Probe	WRT-BTA	$79
Dissolved Oxygen Probes	DO-BTA	$209	ORP Sensor	ORP-BTA	$79	Turbidity Sensor	TRB-BTA	$112
NEW Vernier Optical DO Probe	ODO-BTA	$379	pH Sensor	PH-BTA	$79	UVA Sensor	UVA-BTA	$106
Drop Counter †	VDC-BTD	$99	pH Sensor, Tris-Compatible Flat	FPH-BTA	$99	UVB Sensor	UVB-BTA	$107
Dual-Range Force Sensor	DFS-BTA	$109	Photogate †	VPG-BTD	$45	Voltage Probes		
EKG Sensor	EKG-BTA	$147	Polarimeter (Chemical) †	CHEM-POL	$499	Differential Voltage Probe	DVP-BTA	$39
Electrode Amplifier	EA-BTA	$40	Power Amplifier †	PAMP	$199	Voltage Probe	VP-BTA	$12
NEW Ethanol Sensor †	ETH-BTA	$109	Projectile Launcher †	VPL	$299	30-Volt Voltage Probe	30V-BTA	$49

* Sensors connected to a LabQuest Mini can be used in combination with our 13 supported USB sensors including Go!Temp, Go!Motion, Vernier GPS, and more. † Not supported with Logger Lite software

Go!Link®

USB Interface

A quick and affordable way to get started with data-collection technology.

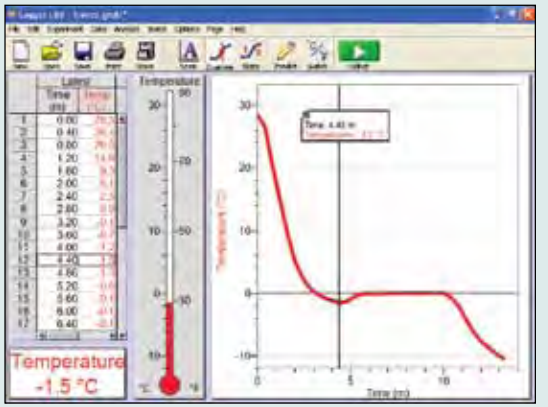
- Single-channel interface connects any one of 54 Vernier sensors to your computer's USB port. (See list of sensors below.)
- Dozens of experiments from our popular lab books can be conducted using Go!Link.

Go!Link, ORDER CODE **GO-LINK, $61**
Includes Logger Lite Software

Teacher Pack of 8 Go!Links, ORDER CODE **GL-TP, $473**
Includes Logger Lite Software

ONLY $61

FREE LOGGER LITE SOFTWARE



Real-Time Graphing

Go!Link, Go!Temp, and Go!Motion include Logger Lite software with purchase.

PROMETHEAN ACTIVBOARD ENABLED

Rather than tell students that water changes state at 0°C, let them see it for themselves! You can also investigate magnetic fields, gravity, and force with hands-on exploration and activities to help reinforce scientific concepts.

- Collect data using one or more sensors
- Calculate statistics
- Store runs
- Annotate graphs
- Print graphs
- Write reports
- Easily export data and graphs
- And much more!

Logger *Pro* 3

Want to import experiment movies and synchronize data with video? You'll want Logger *Pro*. Logger *Pro* 3 software, ORDER CODE **LP, $229**

For more advanced software features, buy just one copy—site license for **ALL school and students' personal computers** is included! See pp. 18-21 for details.

GO!LINK COMPATIBLE SENSORS

SENSOR	CODE	PRICE	SENSOR	CODE	PRICE	SENSOR	CODE	PRICE
Accelerometers			Gas Pressure Sensor	GPS-BTA	$83	Salinity Sensor	SAL-BTA	$92
25-g Accelerometer	ACC-BTA	$92	NEW Goniometer	GNM-BTA	$159	Soil Moisture Sensor	SMS-BTA	$95
Low-g Accelerometer	LGA-BTA	$89	Hand Dynamometer	HD-BTA	$99	Sound Level Meter	SLM-BTA	$165
Anemometer	ANM-BTA	$89	Hand-Grip Heart Rate Monitor	HGH-BTA	$119	Spirometer	SPR-BTA	$199
Barometer	BAR-BTA	$71	Instrumentation Amplifier	INA-BTA	$59	Temperature Probes		
Blood Pressure Sensor	BPS-BTA	$105	Ion-Selective Electrodes			Extra-Long Temperature Probe	TPL-BTA	$79
Charge Sensor	CRG-BTA	$75	Ammonium Ion-Selective Electrode	NH4-BTA	$179	Infrared Thermometer	IRT-BTA	$169
CO_2 Gas Sensor	CO2-BTA	$249	Calcium Ion-Selective Electrode	CA-BTA	$179	Stainless Steel Temperature Probe	TMP-BTA	$29
Colorimeter	COL-BTA	$115	Chloride Ion-Selective Electrode	CL-BTA	$179	Surface Temperature Sensor	STS-BTA	$23
Conductivity Probe	CON-BTA	$95	Nitrate Ion-Selective Electrode	NO3-BTA	$179	Thermocouple	TCA-BTA	$69
Constant Current System	CCS-BTA	$59	Light Sensor	LS-BTA	$55	Wide-Range Temperature Probe	WRT-BTA	$79
Current Probes			Magnetic Field Sensor	MG-BTA	$58	Turbidity Sensor	TRB-BTA	$112
Current Probe	DCP-BTA	$39	Melt Station	MLT-BTA	$449	UVA Sensor	UVA-BTA	$106
High Current Sensor	HCS-BTA	$79	O_2 Gas Sensor	O2-BTA	$188	UVB Sensor	UVB-BTA	$107
Dissolved Oxygen Probe	DO-BTA	$209	ORP Sensor	ORP-BTA	$79	Voltage Probes		
Dual-Range Force Sensor	DFS-BTA	$109	pH Sensor	PH-BTA	$79	Differential Voltage Probe	DVP-BTA	$39
EKG Sensor	EKG-BTA	$147	pH Sensor, Tris-Compatible Flat	FPH-BTA	$99	Voltage Probe	VP-BTA	$12
Electrode Amplifier	EA-BTA	$40	NEW Pyranometer	PYR-BTA	$199	30-Volt Voltage Probe	30V-BTA	$49
Flow Rate Sensor	FLO-BTA	$129	Relative Humidity Sensor	RH-BTA	$69			
Force Plate	FP-BTA	$225	Respiration Monitor Belt *(Requires GPS-BTA)*	RMB	$63			

Go!Temp®

USB Temperature Probe

Collect temperature data for only $39! Go!Temp plugs directly into your computer's USB port without the need for an additional interface. This rugged, stainless-steel temperature probe engages your students in hands-on science as they explore temperature investigations.

Tech Specs:
Range: -20 to 115°C
Max temp without damage: 150°C

ONLY $39

Go!Temp
ORDER CODE **GO-TEMP, $39**
Includes Logger Lite Software

Teacher Pack of 8 Go!Temps
ORDER CODE **GT-TP, $299**
Includes one copy of Logger Lite Software

Media & Methods AWARDS PORTFOLIO WINNER 2005

Technology & Learning WINNER 2004 Award of EXCELLENCE

MultiMedia & Internet@Schools

Go!Motion®

USB Motion Detector

- Teach important concepts in physics and physical science, such as position, velocity, and acceleration.
- Study the motion of a ball tossed in the air or a cart on a ramp.
- Engage your students with hands-on activities.

Go!Motion
ORDER CODE **GO-MOT, $109**
Includes Logger Lite Software

Teacher Pack of 8 Go!Motions
ORDER CODE **GO-MOT-TP, $846**
Includes one copy of Logger Lite Software

Teacher's Choice Award 2013 Technology & Learning Magazine For the Classroom

Technology & Learning WINNER 2005 Award of EXCELLENCE

Head pivots to align with your experiment

Sensitivity switch optimizes data collection to suit your apparatus

Connects directly to a USB port (USB cable included)

ONLY $109

MORE ONLINE – Go!Motion can also be used with Logger *Pro* software. Go!Motion can be used with LabPro, LabQuest 2, LabQuest, LabQuest Mini, CBL 2, TI-Nspire Lab Cradle, or a TI graphing calculator. Visit our web site for more information at **www.vernier.com/go-mot**

GO! QUICK-START PACKAGE

ORDER CODE **GO-QSP, $108**

Includes:

- Go! Link interface and FREE Logger Lite Software
- Our award-winning Go!Temp USB temperature probe
- A TI Light Probe for measuring light intensity

ONLY $108

Logger *Pro* 3

Real-Time Graphing and Powerful Analytical Tools

Logger *Pro* is our flagship data-collection and analysis application for Windows and Mac. With the complete suite of data collection and analysis tools, Logger *Pro* is suitable for all students, beginning to advanced.

- Logger *Pro* is the most popular data-collection program in science education. Why? Teachers tell us that students find our software to be very easy and intuitive to use.
- One program does it all—for only $229—for all of your computers AND your students' personal computers.
- Think of Logger *Pro* as the digital data hub of your classroom and lab. It can gather data from a variety of sources, including LabQuest 2, original LabQuest, LabQuest Mini, LabPro, Go! devices, Ohaus balances, compatible TI graphing calculators, spectrometers, GPS units, manual entry, and more. And now, Logger *Pro* shares data wirelessly with iPad and other mobile devices.

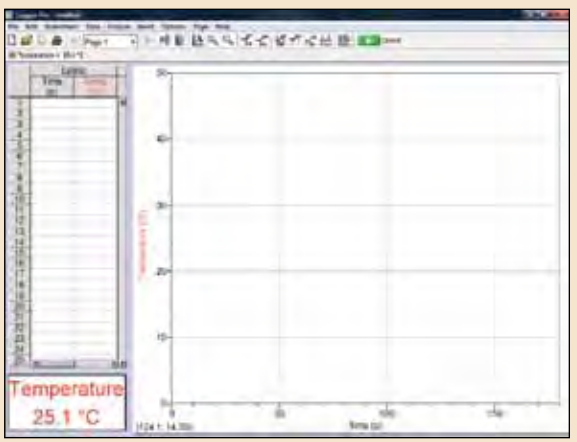
Don't need all this power or working with younger students? Logger Lite, a streamlined subset of Logger *Pro*, is available at no charge for use with LabQuest 2, LabQuest Mini, Go!Temp, Go!Link, and Go!Motion.

AWARD-WINNING

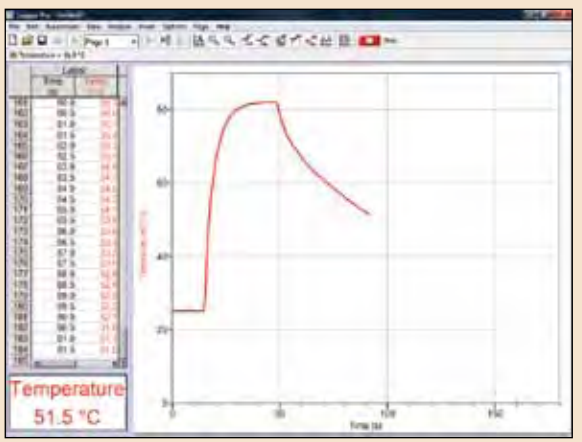
LOGGER *PRO* 3

$229 ORDER CODE **LP** GREAT VALUE!

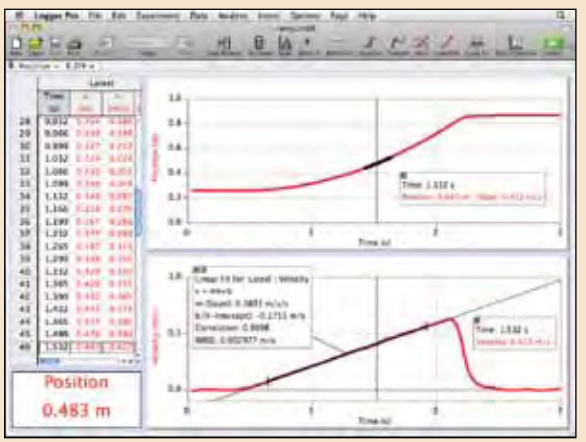
- Logger *Pro* 3 includes a site license for your entire school or college department.
- Site license includes home computers of faculty.
- Site license includes home computers of students—let them take it home!
- No need to count computers to satisfy licensing.
- Logger *Pro* 3 updates are free.
- **NEW** Logger *Pro* 3 Data Sharing
  - Supports Graphical Analysis for iPad and Vernier Data Share web app for other mobile devices and computers.
  - Streams data to multiple devices, allowing for 1:1 learning in lab groups and classrooms.



Start Logger Pro *with a temperature sensor connected. A graph, data table, and meter are all ready to go. Click Collect, and you're taking data.*



After you click Collect, Logger Pro *draws the graph in real time, and the data table and digital meter update continuously.*

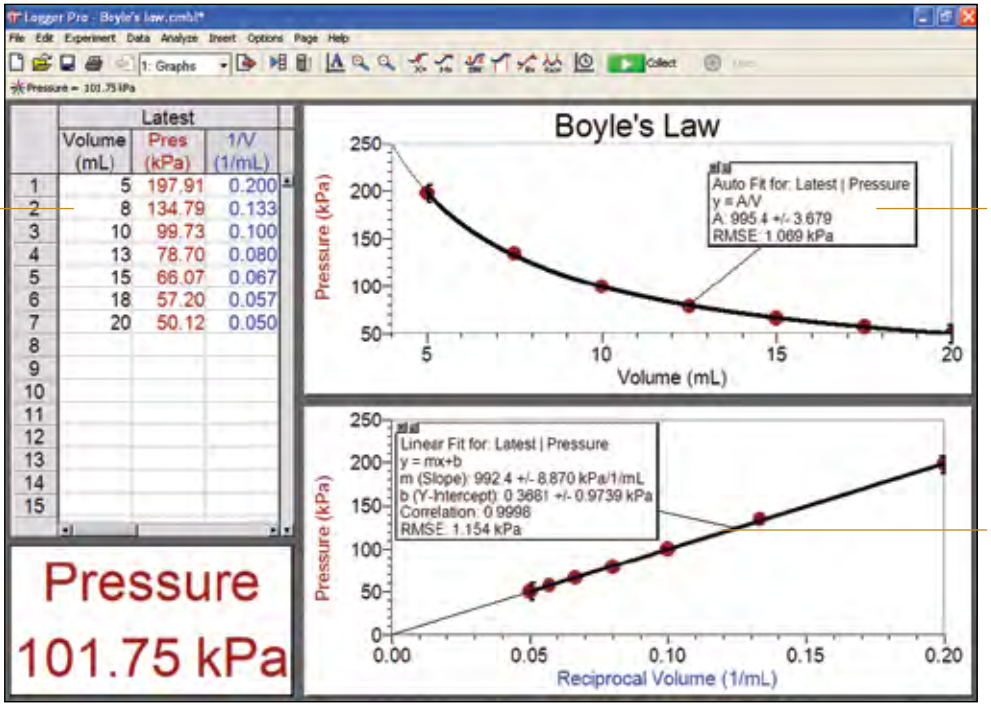


Draw tangent lines to find local slopes and fit lines to selected regions—the analysis tools you need in Logger Pro *are at your fingertips.*

Basic Features

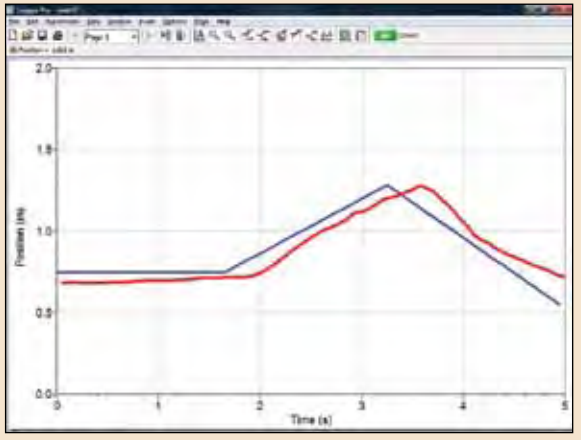
- Ease of use: connect a sensor, launch Logger *Pro,* and click Collect. Auto-ID sensors make setup effortless.
- Collect live data from more than 80 different sensors and devices.
- Draw predictions on a graph before collecting data.
- Use a variety of data-collection modes as needed for your experiment: time-based data, selected events, events with typed-in entries, photogate, radiation counting, and more.
- Manually enter data for graphing and analysis. All of the functions of Vernier's popular Graphical Analysis desktop application are available in Logger *Pro*.
- Import data from LabQuest and calculators.
- Lay out graphs, tables, and text as needed across multiple pages to describe your experiment.
- Read values and slope from graphs using examine and tangent line tools.
- Print graphs and data tables.

See data presented in many ways: tables, graphs, curve fits, and more.

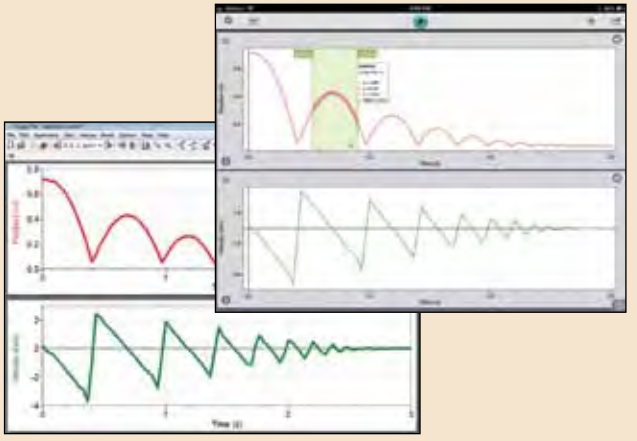


Curve fits show uncertainties in fit parameters. Choose from a library of built-in functions or enter your own.

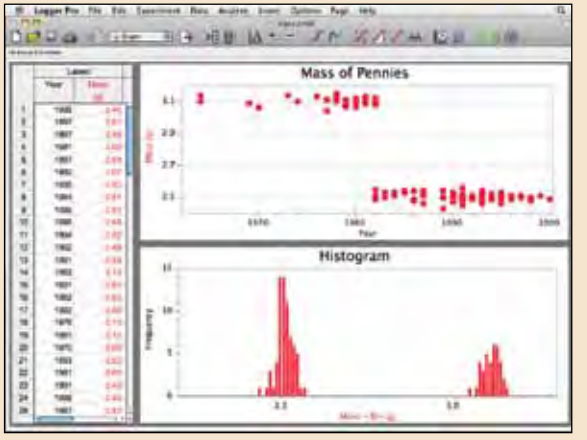
Replot data to show new relationships.



Logger Pro *automatically creates target graphs for graph-matching exercises.*

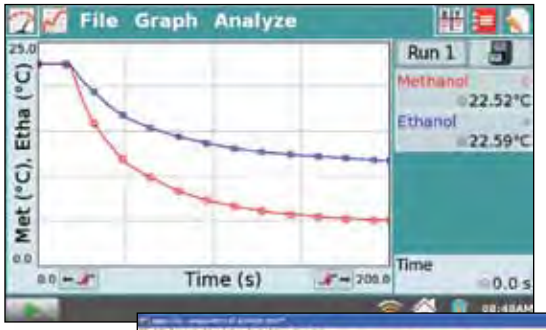


Share Logger Pro *data with Graphical Analysis for iPad.*

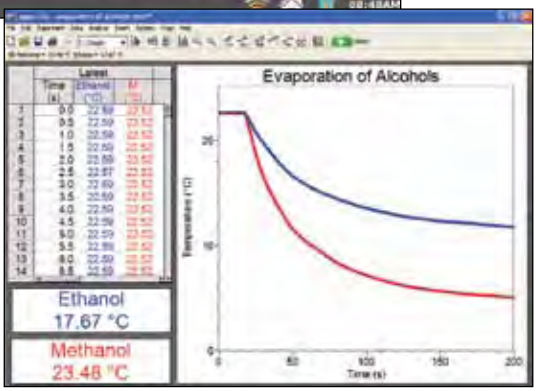


Logger Pro *includes all the premier analysis tools of Graphical Analysis. Use directly captured sensor data as well as imported and manually entered data.*

Easily download your data from the LabQuest App to a computer for further analysis with Logger *Pro* software.



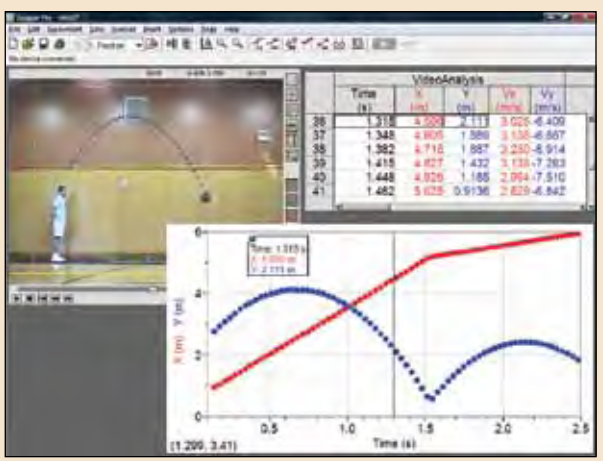
LabQuest App



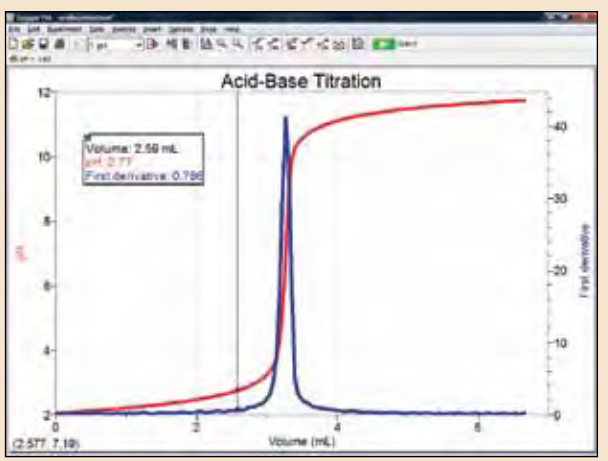
Logger Pro

Advanced Features

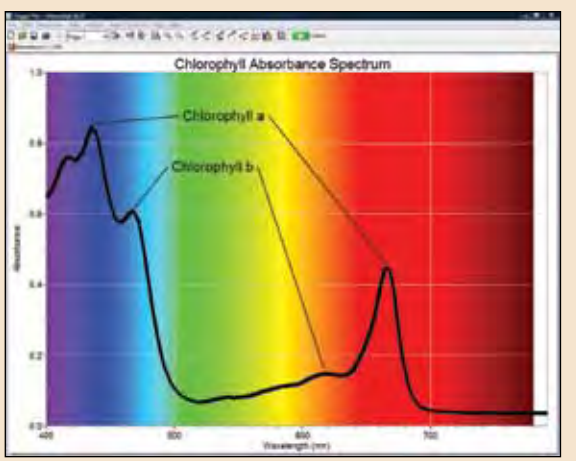
- Graph data in a variety of ways, including XY graphs, log graphs, double-Y graphs, strip charts, and FFT graphs.
- Model data with user-adjustable functions.
- Extract data from movies using frame-by-frame video analysis.
- Capture video from DV cameras and web cameras or import compatible movie files.
- Sync movie playback with sensor data.
- Analyze images of gel electrophoresis.
- Calculated columns allow you to graph new quantities such as kinetic energy.
- Enhance graphs with date and time stamps.
- Supports Vernier and Ocean Optics spectrometers.
- Geolocate and map sensor data with GPS support.
- Perform GC peak analysis.
- Meet IB course goals with manual configuration mode.



Analyze videos to study the motion of individual or multiple objects. This feature alone is worth the price of Logger Pro*!*



Create double-Y graphs to tell complex stories with simplicity.



Collect absorbance data from the Vernier Spectrometer, Ocean Optics spectrometers, or Vernier SpectroVis Plus.

LOGGER *PRO* IS COMPATIBLE WITH:

Vernier LabQuest 2 and Original LabQuest – Collect live data from LabQuest, retrieve existing data, or open saved files on LabQuest. Compatible with 78 different sensors.

Vernier LabQuest Mini – Connect a LabQuest Mini and use 68 different sensors.

Vernier LabPro – Connect a LabPro to collect data with 68 sensors.

Go!Temp, Go!Link, and Go!Motion – Connect any of our Go! sensors and get advanced analysis tools in Logger *Pro*.

Wireless Dynamics Sensor System – See real-time graphing of acceleration, force, and altitude data via wireless Bluetooth connection.

Spectrometers – Collect data directly from Ocean Optics spectrometers and Vernier SpectroVis Plus.

Graphical Analysis for iPad – View and analyze data streamed from Logger *Pro* to multiple iPad devices and auto-save data for later work.

Digital Bioimaging Systems/ProScope HR – Capture images and study DNA with Logger *Pro*'s gel analysis feature.

Vernier Mini GC Plus – Collect and analyze GC data with peak analysis features.

TI Graphing Calculators – Use a TI Connectivity Cable to import data into Logger *Pro* from any supported TI graphing calculators.

Vernier GPS Sensor – Record latitude, longitude, altitude, speed, and direction along with data collected from other sensors. Create spatial visualizations with built-in Google Maps export.

Video Clips – Capture video clips and synchronize with sensor data or perform video analysis.

Manual Entry – Enter data manually, do further analysis, or write lab reports.

Android Tablets – View and analyze Logger *Pro* data in the Chrome™ browser and continue work later in offline mode.

Teach Graphing and Analysis Skills with Logger *Pro*

High School

- Calculated columns allow graphing of derived data; for example, plot the square of the pendulum length for one axis
- Modeling feature lets students superimpose mathematical functions on their data

Middle School

- Easy unit switching helps teach measurement units
- Data export to InspireData™
- Time-of-day graphs for weather or other long-term studies

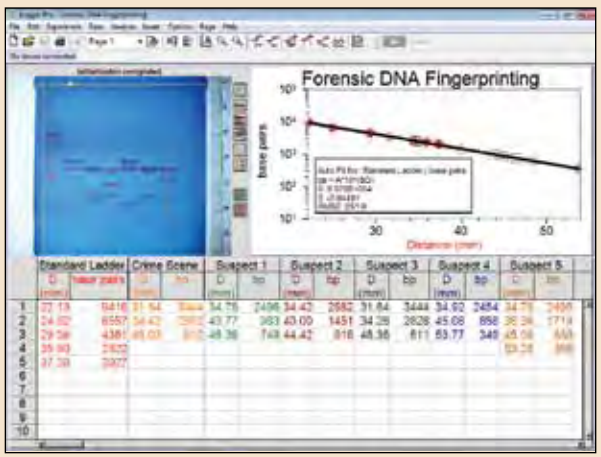
College and University

- Includes advanced graphing features like log graphs and semi-log graphs
- Custom curve fits allow sophisticated models
- Compatible with advanced Ocean Optics spectrometers

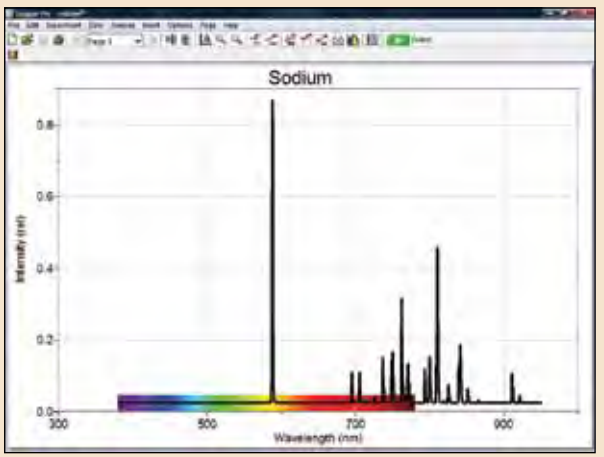
Logger *Pro* 3, ORDER CODE **LP, $229**
One CD for Mac OS X and Windows

Logger *Pro* Student 5-Pack, ORDER CODE **LP-ST5, $10**

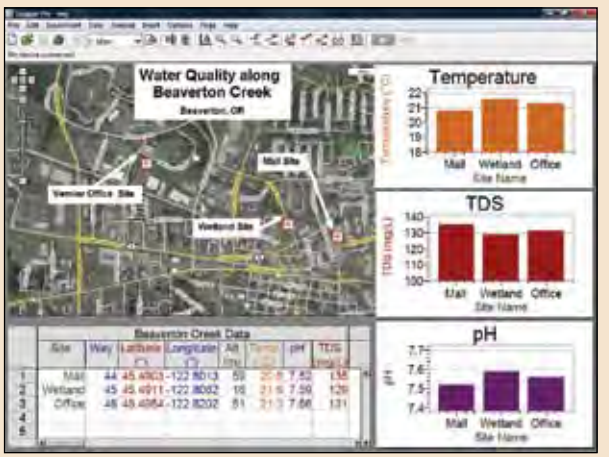
See **www.vernier.com/loggerpro**
for upgrade and system compatibility information



Use one of our digital bioimaging systems, along with Logger Pro, *to analyze gel electrophoresis data.*



Use the Ocean Optics Red Tide Spectrometer to study emission lines from discharge lamps.



Export water quality data to Google Maps and incorporate the result into a Logger Pro *page.*

Graphical Analysis™ for iPad®

Available on the App Store

Gear Up for iPad Data Analysis

Each student in a lab group can collect, view, analyze, and annotate data from Vernier sensors. Later, they can present their results to teachers and classmates.

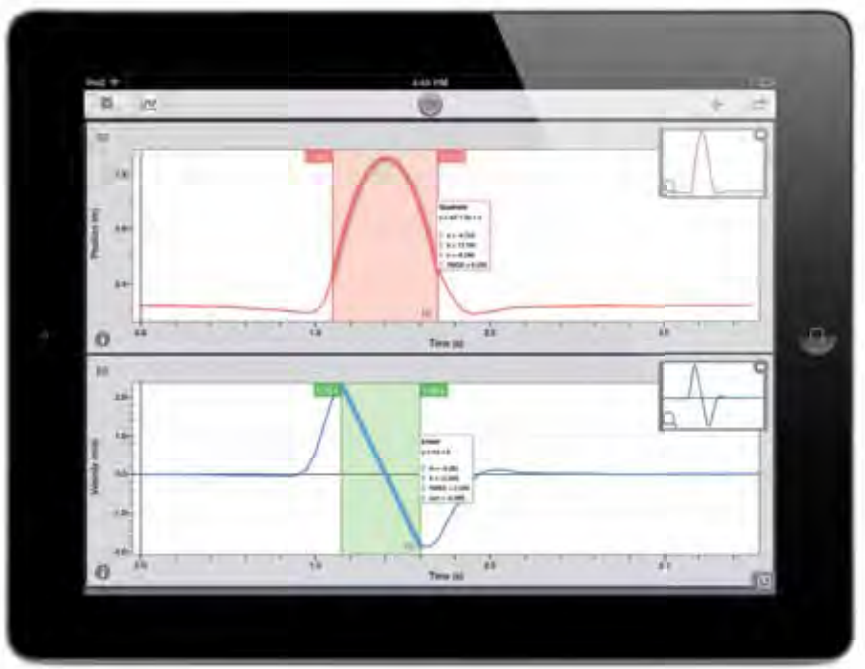
Data Collection

- Wirelessly stream data from LabQuest 2 and Logger *Pro* to multiple students.
- Use multiple sensors simultaneously.
- Start and stop data collection from the app.
- View data as a graph or in a table.
- Manually enter data.

Data Analysis

- Perform curve fits, including linear, quadratic, natural exponent, and more.
- Personalize graphs with data selections, text annotations, titles, and comments.
- Perform statistical calculations: minimum, maximum, mean, standard deviation, range, and number of samples.
- Import LabQuest, Logger *Pro* 3, Graphical Analysis (PC/Mac), and CSV files.
- Export to Logger *Pro* for further analysis.

For more information, **visit www.vernier.com/ga-ipad**



VIDEO PHYSICS

Perform Video Analysis on iPad, iPhone, and iPod touch

Now you can take the video analysis power of Logger *Pro* into the field. Record video on the spot, analyze the movie frame by frame, and export to Logger *Pro* for even deeper analysis.

Get started right away with one of the included sample movies. Track an object using our novel multi-touch cursor and set the video scale. View graphs of the trajectory, position, and velocity as a function of time. You can also rotate the coordinate system, as needed.

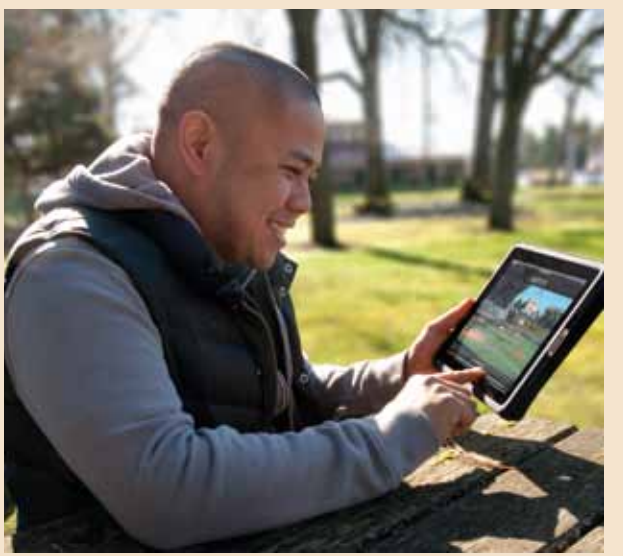
Once you've finished analysis, you can send your work to Logger *Pro* for further analysis or printing. Your project is stored within the app for later reference.

What motion will you analyze?

For more info, visit **www.vernier.com/videophysics**

Available on the App Store

//CODiE// 2012 SIIA CODiE FINALIST



iPad, iPhone, and iPod touch are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

Experiment 31C from* Biology with Vernier, *"Photosynthesis and Respiration"

BIOLOGY

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1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 14–15.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our biology lab book.

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 18–21 for details.

Build custom packages online at www.vernier.com/guide

BIOLOGY LAB BOOK

$48 ORDER CODE **BWV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 31 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/bwv**

Biology with Vernier lab book contains the following experiments:

☐ ☑ **USING TEMPERATURE PROBES**
- Biodiversity and Ecosystems
- Energy in Food
- Aerobic Respiration
- Dissolved Oxygen in Water
- Watershed Testing
- Physical Profile of a Lake

☐ ☑ **USING A GAS PRESSURE SENSOR**
- Testing Catalase Activity
- Transpiration
- Cell Respiration
- Sugar Fermentation
- Effect of Temperature on Fermentation
- Osmosis
- Lactase Action
- Control of Human Respiration

☑ **USING AN EKG SENSOR**
- Monitoring EKG

☐ ☑ **USING A HEART RATE MONITOR**
- Heart Rate and Physical Fitness
- Ventilation and Heart Rate

☐ ☑ **USING A CO_2 GAS SENSOR**
- ▶ Cell Respiration
- Respiration of Sugars by Yeast
- Effect of Temperature on Respiration
- Temperature of Cold-Blooded Organisms
- Lactase Action
- Photosynthesis and Respiration

☑ **USING A COLORIMETER**
- Photosynthesis
- Alcohol & Biological Membranes
- Biological Membranes
- Population Dynamics

☑ **USING A RESPIRATION MONITOR BELT**
- Control of Human Respiration

☑ **USING AN O_2 GAS SENSOR**
- Photosynthesis and Respiration
- ▶ Enzyme Action
- ▶ Cell Respiration
- Oxygen Gas and Human Respiration
- Cold-Blooded Organisms

☑ **USING A CONDUCTIVITY PROBE**
- Limitations on Cell Size
- Diffusion through Membranes
- Conducting Solutions
- Watershed Testing
- Physical Profile of a Lake

☑ **USING A DISSOLVED OXYGEN PROBE**
- Interdependence of Plants and Animals
- Aerobic Respiration
- Dissolved Oxygen in Water
- Watershed Testing
- Physical Profile of a Lake
- Primary Productivity

☑ **USING A pH SENSOR**
- Acids and Bases
- Interdependence of Plants and Animals
- Acid Rain
- Watershed Testing
- Physical Profile of a Lake

☐ STARTER PACKAGES ☑ DELUXE PACKAGES ▶ VIDEO ONLINE

Biology LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-BIO-ST	Deluxe Package LQ2-BIO-DLX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	$119
Gas Pressure Sensor	GPS-BTA	$83	$83
CO_2 Gas Sensor	CO2-BTA	$249	$249
O_2 Gas Sensor	O2-BTA		$188
Conductivity Probe	CON-BTA		$95
pH Sensor	PH-BTA		$79
Colorimeter	COL-BTA		$115
Dissolved Oxygen Probe*	DO-BTA		$209
EKG Sensor	EKG-BTA		$147
BioChamber 250	BC-250		$6
BioChamber 2000	BC-2000		$19
Respiration Monitor Belt	RMB		$63
PACKAGE PRICE		**$809**	**$1,730**

DELUXE

STARTER

YOU WILL ALSO NEED:

Biology with Vernier **lab book,** ORDER CODE **BWV, $48**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,678 EACH AND **SAVE $416!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-BIO-ST	Deluxe Package LM-BIO-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	$119
Gas Pressure Sensor	GPS-BTA	$83	$83
CO_2 Gas Sensor	CO2-BTA	$249	$249
O_2 Gas Sensor	O2-BTA		$188
Conductivity Probe	CON-BTA		$95
pH Sensor	PH-BTA		$79
Colorimeter	COL-BTA		$115
Dissolved Oxygen Probe*	DO-BTA		$209
EKG Sensor	EKG-BTA		$147
BioChamber 250	BC-250		$6
BioChamber 2000	BC-2000		$19
Respiration Monitor Belt	RMB		$63
PACKAGE PRICE		**$629**	**$1,550**

DELUXE

STARTER

YOU WILL ALSO NEED:

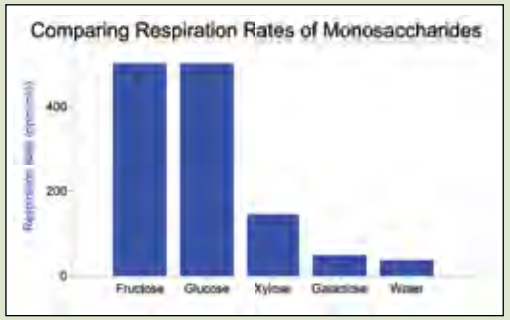
Biology with Vernier **lab book,** ORDER CODE **BWV, $48**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,504 EACH AND **SAVE $368!**

*Deluxe packages containing the new Vernier Optical DO Probe will be available Spring 2013.

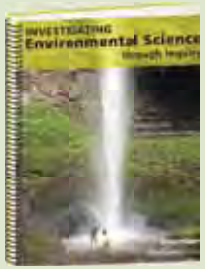
SUGAR METABOLISM WITH YEAST



Using a CO2 Gas Sensor to measure the respiration rates of yeast fed various monosaccharides

MORE ONLINE – For a complete correlation of Vernier labs with AP biology lab objectives, visit **www.vernier.com/ap**

WE ALSO RECOMMEND:



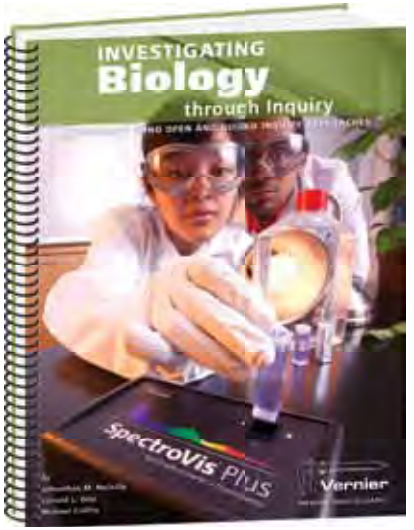
***Investigating Environmental Science through Inquiry* lab book**

ORDER CODE
ESI
$48

Highly recommended for AP*, IB†, and college environmental science. *Investigating Environmental Science through Inquiry* contains 34 inquiry-based, environmental science investigations. See page 64.

*AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

†The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.



BIOLOGY INQUIRY LAB BOOK

$48 ORDER CODE **BIO-I** GREAT VALUE!

Investigating Biology through Inquiry will help you integrate inquiry into your curriculum whether you teach AP*, IB†, or college biology. This inquiry book is designed to meet the new requirements for inquiry in AP biology. This lab book is loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Complete student preliminary activities with step-by-step instructions, data tables, and questions.
- Teacher Information section for each investigation with complete directions for setting up, helpful hints, and sample graphs and data.
- Word-processing files of the student sections on a CD so that any investigation may be easily edited to your specifications (Microsoft® Word® files).
- CD includes both open and guided inquiry approaches to student preliminary activities.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/bio-i**

Investigating Biology through Inquiry lab book includes the following investigations:

USING A TEMPERATURE PROBE
- Water Monitoring
- Sugar Metabolism with Yeast
- Fermentation with Yeast

USING A CONDUCTIVITY PROBE
- Diffusion
- Water Monitoring

USING AN O_2 GAS SENSOR
- Testing Catalase Activity (O_2)

USING A pH SENSOR
- Investigating Buffers
- Water Monitoring

USING A HEART RATE MONITOR
- Heart Rate

USING A CO_2 GAS SENSOR
- Cellular Respiration
- Sugar Metabolism with Yeast
- Evolution of Yeast: Artificial Selection

USING A DISSOLVED OXYGEN SENSOR
- Investigating Dissolved Oxygen
- Investigating Primary Productivity
- Water Monitoring

USING A GAS PRESSURE SENSOR
- Transpiration of Plants
- Testing Catalase Activity (Gas Pressure)
- Investigating Osmosis
- Fermentation with Yeast

USING A WHITE DIGITAL BIOIMAGING SYSTEM
- Introduction to Molecular Evolution

USING A SPECTROVIS PLUS
- Plant Pigments
- Chemistry of Membranes
- Photosynthesis of Chloroplasts
- Evolution of Cellobiase in Fungi
- Analysis of Enzymes using Tyrosinase
- Introduction to Biofuels: Enzyme Action
- Investigating Protein: The Bradford Assay

STARTER PACKAGES DELUXE PACKAGES VIDEO ONLINE

Did you know?

Vernier Optical DO Probe, ORDER CODE **ODO-BTA, $379** Available Spring 2013

The Vernier Optical DO Probe makes it easy to measure the dissolved oxygen concentration in water. Perfect for the field or for the laboratory, this plug-and-play probe requires no calibration, no filling solution, no warm-up time, and no stirring. For more details, see page 35.

Biology Inquiry LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-BINQ-ST	Deluxe Package LQ2-BINQ-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
SpectroVis Plus Spectrophotometer	SVIS-PL	$459	$459
CO_2 Gas Sensor	CO2-BTA		$249
Conductivity Probe	CON-BTA		$95
Dissolved Oxygen Probe*	DO-BTA		$209
O_2 Gas Sensor	O2-BTA		$188
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
pH Sensor	PH-BTA		$79
PACKAGE PRICE		**$900**	**$1,839**

YOU WILL ALSO NEED:

Investigating Biology through Inquiry **lab book**
ORDER CODE **BIO-I, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,784 EACH AND **SAVE $440!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-BINQ-ST	Deluxe Package LM-BINQ-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
SpectroVis Plus Spectrophotometer	SVIS-PL	$459	$459
CO_2 Gas Sensor	CO2-BTA		$249
Conductivity Probe	CON-BTA		$95
Dissolved Oxygen Probe*	DO-BTA		$209
O_2 Gas Sensor	O2-BTA		$188
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
pH Sensor	PH-BTA		$79
PACKAGE PRICE		**$720**	**$1,659**

YOU WILL ALSO NEED:

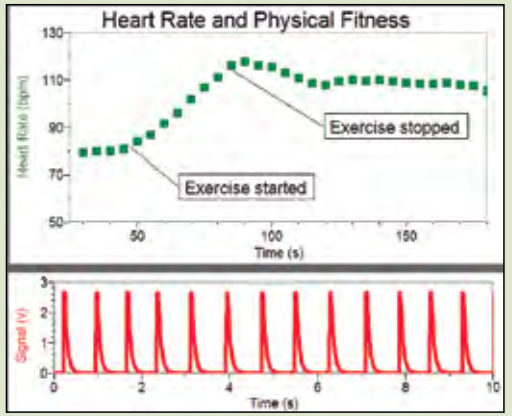
Investigating Biology through Inquiry **lab book**
ORDER CODE **BIO-I, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,609 EACH AND **SAVE $400!**

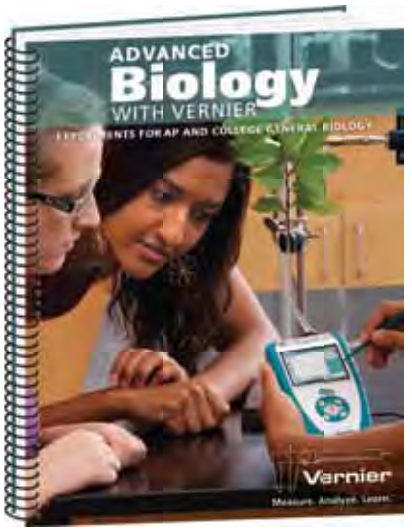
*Deluxe packages containing the new Vernier Optical DO Probe will be available Spring 2013.

HEART RATE AND PHYSICAL FITNESS



Using a Hand-Grip Heart Rate Monitor to determine how exercise affects heart rate

Interested in Environmental Science, Agricultural Science, Human Physiology, or Forensics lab books? See pages 100 and 103.



ADVANCED BIOLOGY LAB BOOK

$48 ORDER CODE **BIO-A** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 17 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/bio-a**

Advanced Biology with Vernier lab book contains the following experiments. (For inquiry-based biology experiments, see page 26.)

USING A TEMPERATURE PROBE
- Dissolved Oxygen in Water

USING A GAS PRESSURE SENSOR
- Transpiration
- ▶ Cell Respiration
- Osmosis
- Enzyme Action

USING A CO_2 GAS SENSOR
- ▶ Cell Respiration

USING AN O_2 GAS SENSOR
- ▶ Enzyme Action
- ▶ Cell Respiration

USING A HEART RATE MONITOR
- Heart Rate and Physical Fitness

USING A COLORIMETER OR SPECTROVIS® PLUS SPECTROPHOTOMETER
- Enzyme Analysis using Tyrosinase
- Introduction to Neurotransmitters using AChE
- Macromolecules: Experiments with Protein
- Photosynthesis

USING A CONDUCTIVITY PROBE
- Diffusion through Membranes

USING A DISSOLVED OXYGEN PROBE
- Dissolved Oxygen in Water

USING A SPECTROVIS PLUS SPECTROPHOTOMETER
- Visible Spectra of Plant Pigments
- Determination of Chlorophyll in Olive Oil
- Enzyme Analysis using Tyrosinase
- Introduction to Neurotransmitters using AChE
- Macromolecules: Experiments with Protein

USING A BLOOD PRESSURE SENSOR
- Blood Pressure as Vital Sign

(USING BIOIMAGING SYSTEMS)
- pGLO Bacterial Transformation
- Analysis of Precut Lambda DNA: An Introduction to Restriction Enzymes
- Forensic DNA Fingerprinting

NO SENSOR USED
- Mitosis and Meiosis
- Genetics of Drosophila
- Population Genetics and Evolution
- Animal Behavior

STARTER PACKAGES DELUXE PACKAGES ▶ VIDEO ONLINE

Did you know?

Hand Dynamometer, ORDER CODE **HD-BTA, $99**

Our strain-gage based isometric dynamometer can be used to measure grip strength or finger-pinch strength. The Hand Dynamometer makes a great addition to your biology labs. For more details on this sensor, see page 127.

Advanced Biology LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-AB-ST	SpectroVis Plus Deluxe LQ2-AB-SV
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
Conductivity Probe	CON-BTA	$95	$95
CO_2 Gas Sensor	CO2-BTA	$249	$249
O_2 Gas Sensor	O2-BTA		$188
Dissolved Oxygen Probe†	DO-BTA		$209
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
Blood Pressure Sensor	BPS-BTA		$105
BioChamber 250	BC-250		$6
SpectroVis Plus Spectrophotometer*	SVIS-PL		$459
PACKAGE PRICE		**$785**	**$1,871**

SPECTROVIS PLUS DELUXE

STARTER

YOU WILL ALSO NEED:

Advanced Biology with Vernier **lab book**
ORDER CODE **BIO-A, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL department and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 ADVANCED BIOLOGY **SPECTROVIS PLUS** PACKAGES AT $1,815 EACH AND **SAVE $448!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-AB-ST	SpectroVis Plus Deluxe LM-AB-SV
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
Conductivity Probe	CON-BTA	$95	$95
CO_2 Gas Sensor	CO2-BTA	$249	$249
O_2 Gas Sensor	O2-BTA		$188
Dissolved Oxygen Probe†	DO-BTA		$209
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
Blood Pressure Sensor	BPS-BTA		$105
BioChamber 250	BC-250		$6
SpectroVis Plus Spectrophotometer*	SVIS-PL		$459
PACKAGE PRICE		**$605**	**$1,691**

SPECTROVIS PLUS DELUXE

STARTER

YOU WILL ALSO NEED:

Advanced Biology with Vernier **lab book**
ORDER CODE **BIO-A, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL department and students' personal computers is included! See pp. 18-21 for details.

SPECIAL OFFER: BUY 8 ADVANCED BIOLOGY **SPECTROVIS PLUS** PACKAGES AT $1,640 EACH AND **SAVE $408!**

*Deluxe packages substituting a Colorimeter for SpectroVis Plus are available online. †Deluxe packages containing the new Vernier Optical DO Probe will be available Spring 2013.

$799 a

$569 b

Bio-Rad Forensic DNA Fingerprinting Kit

a. Blue Digital Bioimaging System

ORDER CODE **BL-DBS, $799**

The Blue Digital Bioimaging System is a complete solution for photodocumenting and analyzing your electrophoresis gels. With it, you can

- View your gel banding patterns using the BlueView Transilluminator.
- Capture a photograph of the gel on your computer using a ProScope HR.
- Analyze your results by creating a standard curve and calculating the number of base pairs in each band using Logger *Pro* software (not included).

The Blue Digital Bioimaging System includes a BlueView Transilluminator, Imaging Hood, ProScope HR digital USB camera with 1–10X lens, and a ProScope Stand.

b. White Digital Bioimaging System

ORDER CODE **WHT-DBS, $569**

The White Digital Bioimaging System is a complete solution for photodocumenting and analyzing non-fluorescent electrophoresis gels.

- View non-fluorescent gel banding patterns using the White Light Transilluminator.
- Capture a photograph of the gel on your computer using a ProScope HR.
- Analyze your results by creating a standard curve and calculating numbers of base pairs in each band using Logger *Pro* (not included).

The White Digital Bioimaging system includes a White Light Transilluminator, Imaging Hood, ProScope HR digital USB camera with 1–10X lens, and a ProScope Stand.

BIO-RAD Bio-Rad Partnership

Vernier and Bio-Rad have partnered to bring you the best in biotechnology kits, instrumentation, consumables, data collection, analysis, and curricula.

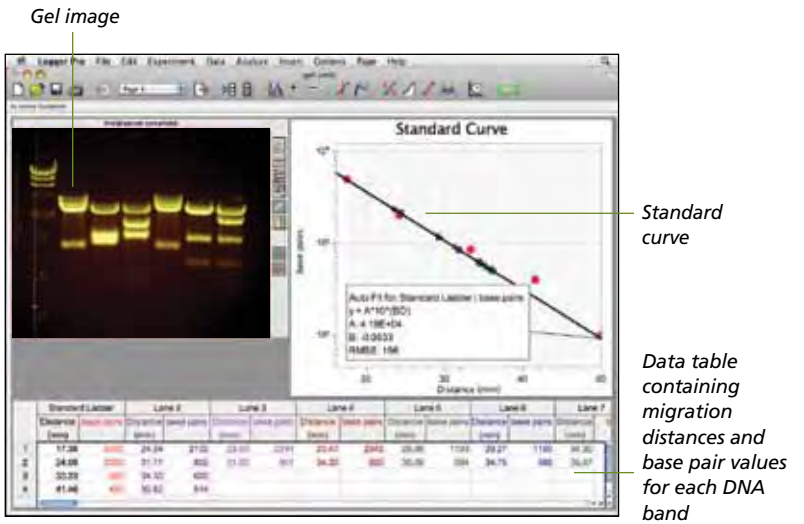
MORE ONLINE – For more information on biotechnology, visit **www.vernier.com/biotech**

Experiment 6B from Advanced Biology with Vernier, *"Analysis of Precut Lambda DNA"*

Three Easy Steps for Gel Analysis

Vernier provides tools for digital photodocumentation and analysis of gel electrophoresis. Here's how it's done:

1. Run your gel.
2. Use one of our Digital Bioimaging Systems to capture a digital photo of the gel in Logger *Pro*. Use Blue if using SYBR Safe stain or White if using Fast Blast™ DNA stain or methylene blue stain.
3. Use the Gel Analysis feature in Logger *Pro* to create a standard curve and determine the number of base pairs in each experimental band.


Gel image
Standard Curve
Standard curve
Data table containing migration distances and base pair values for each DNA band

Using the Gel Analysis feature of Logger Pro *3*

"Plant Pigments" from Investigating Biology through Inquiry

SpectroVis® Plus

Spectrophotometer + Fluorometer

$459 ORDER CODE **SVIS-PL**

Having an array spectrophotometer/fluorometer combination is now affordable for each of your lab stations! SpectroVis Plus spectrophotometer plus fluorometer allows students to collect absorbance, transmittance, and fluorescence data quickly and easily. In absorbance mode, you can quickly and easily measure the absorbance spectrum of a solution, concentrations of solutions, and rates of reactions. With its two different excitation wavelengths, SpectroVis Plus can quantitatively measure the fluorescence spectra of many compounds, such as chlorophyll, fluorescein, GFP, and more. Connect SpectroVis Plus to a LabQuest or a computer running Logger *Pro* using a standard USB cable (included), and see the results in full color.

USES

- Measure absorbance spectrum of a liquid
- Measure fluorescence emission spectrum of a liquid
- Conduct Beer's law investigations
- Conduct kinetic studies of absorbance *vs.* time
- Conduct equilibrium studies of absorbance *vs.* time and/or absorbance *vs.* concentration
- Conduct experiments on enzyme kinetics
- Perform colorimetric or fluorescent bioassays
- Measure emissions of gas discharge tubes or other light sources using the SpectroVis Optical Fiber (not included)

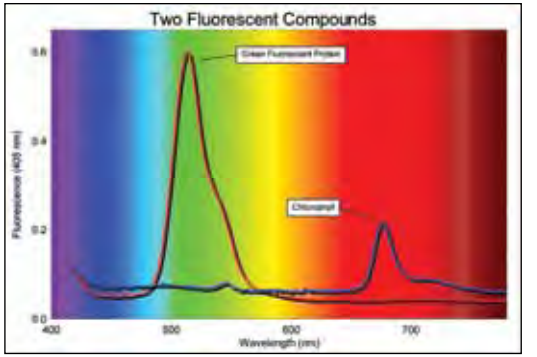
FEATURES

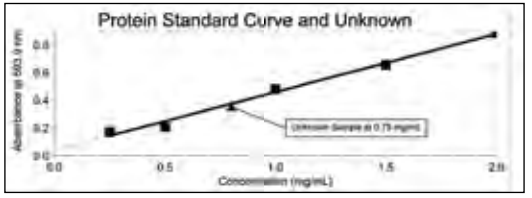
- Portable: 15 cm x 9 cm x 4 cm
- Easy one-step calibration
- Measures absorbance over a 380–950 nm range
- ~2.5 nm optical resolution, 570 wavelengths, 1 nm reporting intervals
- Fluorescence excitation centered at 405 nm or 500 nm
- Powered by computer or LabQuest USB port; no additional power source needed

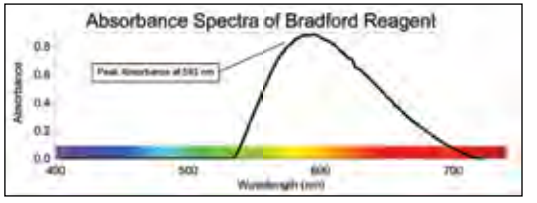
---

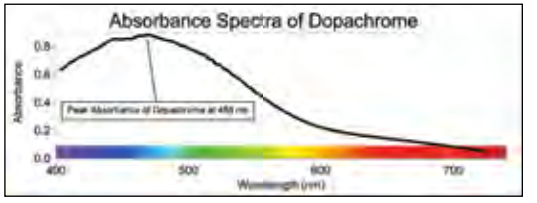
SpectroVis Optical Fiber, ORDER CODE SVIS-FIBER, $69

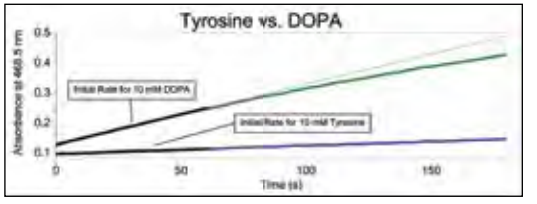
Turn your SpectroVis Plus into an emissions spectrometer using the SpectroVis Optical Fiber insert. Simply insert the unit into the cuvette holder and point the 1 m optical fiber at a light source.











Data from spectrometer labs in Advanced Biology with Vernier *and* Investigating Biology through Inquiry

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest and computers.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 14–15.

3 CHOOSE YOUR SENSORS

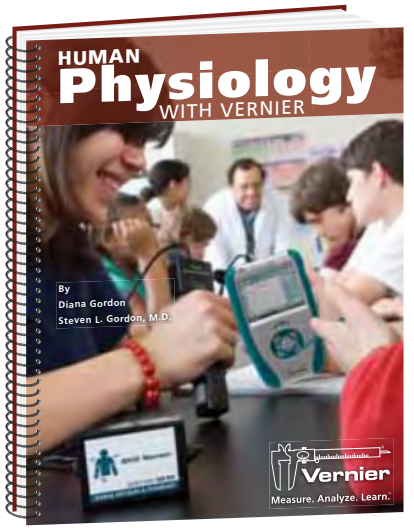
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our physiology lab book.

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 18–21 for details.

Build custom packages online at www.vernier.com/guide



HUMAN PHYSIOLOGY LAB BOOK

$48 ORDER CODE **HP-A** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 24 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest and computer versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/hp-a**

Human Physiology with Vernier lab book contains the following experiments:

USING A SURFACE TEMPERATURE SENSOR
- Warming Function of Nasal Passageways
- Effect of Vascularity on Skin Temperature Recovery

USING A BLOOD PRESSURE SENSOR
- Blood Pressure as a Vital Sign
- Blood Pressure and Exercise
- Diurnal Blood Pressure Variation
- Heart Rate and Blood Pressure as Vital Signs
- Heart Rate, Blood Pressure, and Exercise

USING A HEART RATE MONITOR
- Heart Rate as a Vital Sign
- Heart Rate and Exercise
- Heart Rate Response to Baroreceptor Feedback
- Effect of Coughing on Heart Rate
- Heart Rate and Blood Pressure as Vital Signs
- Heart Rate, Blood Pressure, and Exercise

USING A HAND DYNAMOMETER
- Grip Strength Comparison
- Grip Strength and Muscle Fatigue
- EMG and Muscle Fatigue

USING AN EKG SENSOR
- Analyzing the Heart with EKG
- Introduction to EMG
- Neuromuscular Reflexes (with Accelerometer)
- Neuromuscular Reflexes (without Accelerometer)
- Muscle Function Analysis
- EMG and Muscle Fatigue

USING A SPIROMETER
- Lung Volumes and Capacities
- Respiratory Response to Physiologic Challenges
- Analysis of Lung Function
- Oxygen and Aerobic Metabolism

USING AN O_2 GAS SENSOR
- Oxygen and Aerobic Metabolism
- Oxygen Extraction by the Lungs
- Effect of "Dead Space" on Oxygen Exchange

USING A 25-G ACCELEROMETER
- Neuromuscular Reflexes (with Accelerometer)

STARTER PACKAGES DELUXE PACKAGES VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Did you know?

Our CO_2 Gas Sensor can be used to measure human respiration. The high range can measure up to 100,000 ppm, while the low range, with a maximum of 10,000 ppm, still gives the precision you need for smaller changes in CO_2 gas concentration. The CO_2 Gas Sensor makes a great addition to your human physiology labs. For more details on this sensor, see page 121.

Human Physiology LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-HP-ST	Deluxe Package LQ2-HP-DLX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
EKG Sensor	EKG-BTA	$147	$147
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	$119
Surface Temperature Sensor	STS-BTA	$23	$23
Blood Pressure Sensor	BPS-BTA	$105	$105
Hand Dynamometer	HD-BTA	$99	$99
Spirometer	SPR-BTA		$199
O_2 Gas Sensor	O2-BTA		$188
O_2 Gas Sensor to Spirometer Adapter	O2-SPR		$8
25-g Accelerometer	ACC-BTA		$92
PACKAGE PRICE		**$822**	**$1,309**

YOU WILL ALSO NEED:

Human Physiology with Vernier **lab book**
ORDER CODE **HP-A, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,270 EACH AND **SAVE $312!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-HP-ST	Deluxe Package LM-HP-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
EKG Sensor	EKG-BTA	$147	$147
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	$119
Surface Temperature Sensor	STS-BTA	$23	$23
Blood Pressure Sensor	BPS-BTA	$105	$105
Hand Dynamometer	HD-BTA	$99	$99
Spirometer	SPR-BTA		$199
O_2 Gas Sensor	O2-BTA		$188
O_2 Gas Sensor to Spirometer Adapter	O2-SPR		$8
25-g Accelerometer	ACC-BTA		$92
PACKAGE PRICE		**$642**	**$1,129**

YOU WILL ALSO NEED:

Human Physiology with Vernier **lab book**
ORDER CODE **HP-A, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,095 EACH AND **SAVE $272!**

O_2 Gas Sensor to Spirometer Adapter

ORDER CODE **O2-SPR, $8**

This adapter facilitates the connection between an Oxygen Gas Sensor and a Spirometer. See page 136.

NEW Goniometer

ORDER CODE **GNM-BTA, $159**

The Goniometer measures the angle of a joint. Use it to analyze the range of motion of a limb during different types of physical activity. See page 127.

Force Plate

ORDER CODE **FP-BTA*, $225**

The Force Plate is a large force sensor—tough enough to jump on. Use it to study balance and biomechanics. See page 126.

*Additional shipping charges may apply.

NEW
$109
a

a. NEW Ethanol Sensor

ORDER CODE **ETH-BTA, $109**

Use the Ethanol Sensor to measure the concentration of ethanol in air above an aqueous sample. It can be used to determine the rate of ethanol production during fermentation or to measure the discrete amount of ethanol in a given sample.

$99
b

b. Tris-Compatible Flat pH Sensor

ORDER CODE **FPH-BTA, $99**

The Tris-Compatible Flat pH Sensor uses a double-junction electrode, making it compatible with Tris buffers and solutions containing proteins. The flat glass shape also makes it ideal for measuring the pH of semisolids, such as food or soil.

$44
c

c. Primary Productivity Kit

ORDER CODE **PPK, $44**

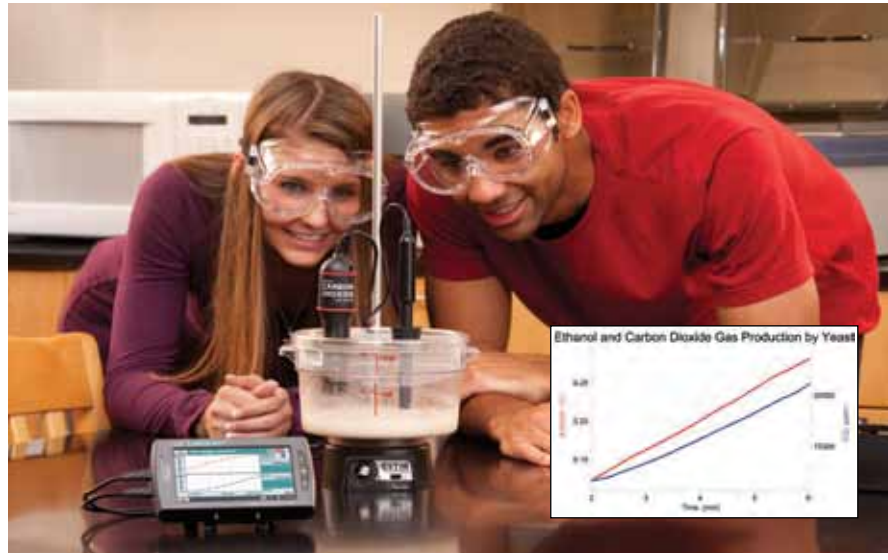
This kit is an accessory for one of our most popular biology labs, Primary Productivity. The kit consists of a box of 7 plastic bottles, 7 rubber stoppers, and a set of screens for controlling the amount of light allowed into each bottle.

d

d. BioChambers

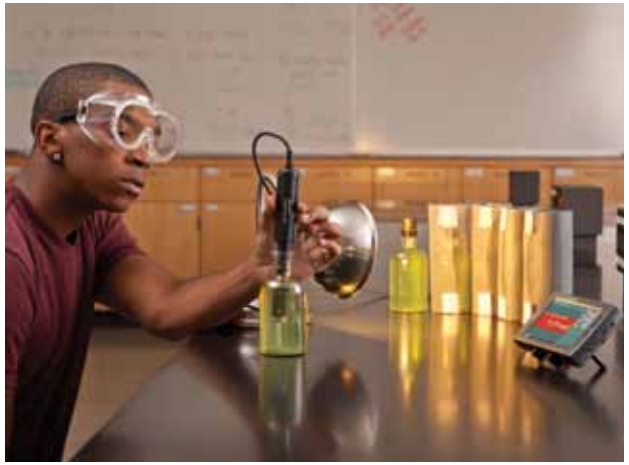
2000 mL, ORDER CODE **BC-2000, $19**
250 mL, ORDER CODE **BC-250, $6**

BioChambers provide a way for both CO_2 Gas and O_2 Gas Sensors, or one of these along with the Ethanol Sensor, to be used at the same time in a closed system.



Measuring CO_2 gas and ethanol production during fermentation

Testing water quality in the Columbia River Gorge



Using the Vernier Optical DO Probe to measure primary productivity

WHICH DO PROBE IS RIGHT FOR ME?

	Vernier Optical DO Probe	Dissolved Oxygen Probe
No calibration required	✔	
No stirring required	✔	
No warm-up time	✔	
No electrode filling solution	✔	
Automatic pressure compensation	✔	
Automatic temperature compensation	✔	✔
Measure in mg/L	✔	✔
Measure in % saturation	✔	
Works with LabQuest and LabQuest Mini	✔	✔
Works with Go!Link		✔
Order code	ODO-BTA	DO-BTA
Cost	$379	$209

NEW Vernier Optical DO Probe

$379 ORDER CODE **ODO-BTA** **Available Spring 2013**

a. Vernier Optical DO Probe, ORDER CODE ODO-BTA, $379

Students can now measure the concentration of dissolved oxygen in water quickly and easily with the new Vernier Optical DO Probe. The Vernier Optical DO Probe uses luminescent technology to provide fast, easy, and accurate measurements of dissolved oxygen concentrations, making it a terrific choice for biology, ecology, or environmental science courses. This probe can be used to measure dissolved oxygen concentration in surface water or to perform a wide variety of experiments to determine changes in dissolved oxygen levels, one of the primary indicators of the quality of an aquatic environment.

- Plug-and-play technology—no filling solution, warm-up time, calibration, or stirring necessary
- Built-in temperature and pressure compensation
- Easy maintenance
- Switch setting allows units of mg/L or % saturation

ACCESSORIES

b. Optical DO Probe Metal Guard

ORDER CODE **ODO-GRD, $45**

Attach the metal guard to the Vernier Optical DO Probe to protect the cap and to help weigh down the probe when submerged.

c. Optical DO Probe Replacement Cap*

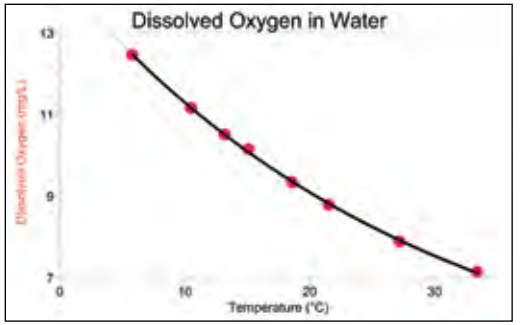
ORDER CODE **ODO-CAP, $49**

The cap on the Vernier Optical DO Probe will need to be replaced every few years.

* Optical DO Probe caps are warranted to be free from defects for a period of twelve (12) months from the date of purchase; it is possible that you may get somewhat longer use than the warranty period.

MORE ONLINE – For more information on the Vernier Optical DO Probe, visit **www.vernier.com/odo-bta**

a **NEW**
$379



Saturated dissolved oxygen at various temperatures

b $45

c $49

ProScope HR™

high resolution handheld microscope

High-Resolution Handheld Microscope

The ProScope HR is a USB handheld digital microscope designed for use with your computer. With a high-quality CMOS and universal lens mount, the ProScope HR can become a powerful addition to any classroom.

- Instantly displays digital images on a computer screen.
- Takes still photos, movies, and time-lapse videos.
- Interchangeable lenses make it easy to get the magnification you need.
- Includes ProScope HR software and works with Logger *Pro*.
- Lens-mounted, white LEDs make lighting subjects simple.
- Lenses also sold separately on our web site at **www.vernier.com/proscope**

All ProScopes carry a two-year warranty.

ProScope HR

ORDER CODE **BD-HRB, $199**

Get started capturing high-resolution microscopic images of hair follicles, the ridges and troughs of your finger prints, and more with the 50X lens.

Includes: ProScope HR Unit, ProScope HR Software, and 50X Lens.

BEST VALUE!

Biology ProScope HR Kit

ORDER CODE **BD-HRBIOL, $599**

Use the ProScope HR as a dissecting microscope or attach the ProScope HR to your regular microscope for even more magnification.

Includes: ProScope HR Unit, ProScope HR Software, 50X Lens, 1-10X Lens, C-Mount Adapter with IR Cut Filter, Microscope Lens Tube Adapter, Camera Stand, Rugged Hard-Side Case

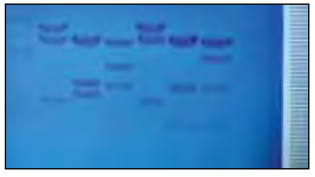
ProScope HR Deluxe Kit

ORDER CODE **BD-DLX, $899**

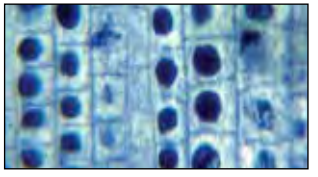
In addition to everything that comes with the Biology ProScope HR Kit, the Deluxe Kit includes two more lenses for maximum magnification at 100X or 200X.

Includes: ProScope HR Unit, ProScope HR Software, 50X Lens, 1-10X Lens, 100X Lens, 200X Lens, C-Mount Adapter with IR Cut Filter, Microscope Lens Tube Adapter, Camera Stand, Rugged Hard-Side Case.

Aphid



Gel electrophoresis



Onion root tip

Lily pollen grain

Use the ProScope HR as a dissecting scope to study insects.

Connect the ProScope HR to a microscope for more powerful magnification.

Higher resolution ProScope HR2 model also available. For details visit ***www.vernier.com/proscope***

Experiment 6 from* Chemistry with Vernier, *"Boyle's Law"

CHEMISTRY

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1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

Also recommended: *Investigating Chemistry through Inquiry* page 40.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 14–15.

3 CHOOSE YOUR SENSORS

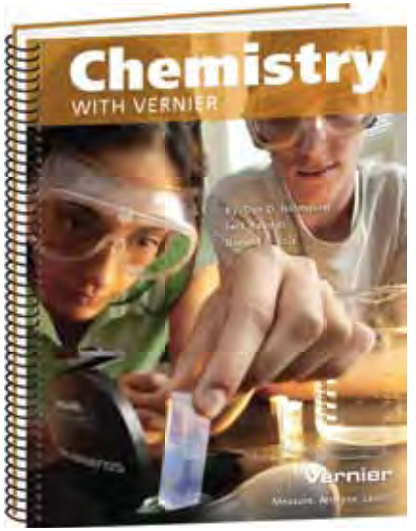
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our chemistry lab book.

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 18–21 for details.

Build custom packages online at www.vernier.com/guide



CHEMISTRY LAB BOOK

$48 ORDER CODE **CWV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information, including instructions for preparing solutions.
- 36 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate the labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/cwv**

Chemistry with Vernier lab book contains the following experiments:

USING TEMPERATURE PROBES
- Endothermic and Exothermic Reactions
- Freezing and Melting of Water
- Another Look at Freezing Temperature
- Heat of Fusion of Ice
- Pressure-Temperature Relationships
- Fractional Distillation
- Evaporation and Intermolecular Attractions
- Vapor Pressure of Liquids
- Effect of Temperature on Solubility
- Finding Molecular Weight
- Energy Content of Foods
- Energy Content of Fuels
- Hess's Law
- Heat of Combustion: Magnesium

USING A pH SENSOR
- Household Acids and Bases
- Acid Rain
- Titration Curves of Acids and Bases
- Acid-Base Titration
- Titration of a Diprotic Acid
- Acid Dissociation Constant, K_a
- Time-Released Vitamin C Tablet
- The Buffer in Lemonade
- Phosphoric Acid Content in Soft Drinks
- Microscale Acid-Base Titration

USING A VOLTAGE PROBE
- Micro-Voltaic Cells
- Lead Storage Batteries

USING A GAS PRESSURE SENSOR
- Boyle's Law: Gas Pressure and Volume
- Pressure-Temperature Relationship
- Vapor Pressure of Liquids

USING A COLORIMETER
- Beer's Law
- Finding an Equilibrium Constant, K_c
- Rate Law Determination of the Crystal Violet Reaction
- Chlorine Content of Swimming Pool Water
- Quantity of Iron in a Vitamin Tablet

USING A CONDUCTIVITY PROBE
- Electrolytes and Non-Electrolytes
- The Effect of Concentration
- Using Conductivity to Find an Equivalence Point

USING A DROP COUNTER *(optional)*
- Acid-Base Titration
- Titration of a Diprotic Acid
- Using Conductivity to Find an Equivalence Point

USING NO SENSOR
- Find the Relationship: An Exercise in Graphical Analysis

STARTER PACKAGES DELUXE PACKAGES VIDEO ONLINE

Chemistry LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-CH-ST	Deluxe Package LQ2-CH-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
pH Sensor	PH-BTA	$79	$79
Gas Pressure Sensor	GPS-BTA	$83	$83
Voltage Probe	VP-BTA	$12	$12
Conductivity Probe	CON-BTA		$95
Colorimeter	COL-BTA		$115
Drop Counter	VDC-BTD		$99
PACKAGE PRICE		**$561**	**$870**

YOU WILL ALSO NEED:

***Chemistry with Vernier* lab book,** ORDER CODE **CWV, $48**
See previous page.

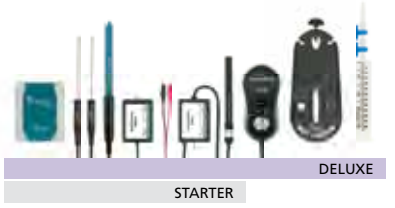
Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $844 EACH AND **SAVE $208**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-CH-ST	Deluxe Package LM-CH-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
pH Sensor	PH-BTA	$79	$79
Gas Pressure Sensor	GPS-BTA	$83	$83
Voltage Probe	VP-BTA	$12	$12
Conductivity Probe	CON-BTA		$95
Colorimeter	COL-BTA		$115
Drop Counter	VDC-BTD		$99
PACKAGE PRICE		**$381**	**$690**



YOU WILL ALSO NEED:

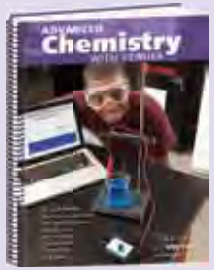
***Chemistry with Vernier* lab book,** ORDER CODE **CWV, $48**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $669 EACH AND **SAVE $168**

Also recommended: *Investigating Chemistry through Inquiry* lab book. See page 40.

WE ALSO RECOMMEND:



Advanced Chemistry with Vernier **lab book**

ORDER CODE
CHEM-A
$48

This book contains 35 advanced chemistry experiments designed for use with Vernier probeware.

AP CHEMISTRY TEACHERS

The AP* Chemistry Course Description, revised for 2013, describes 16 laboratory experiments. Many of the experiments in the *Advanced Chemistry with Vernier* and the *Investigating Chemistry through Inquiry* lab books align well with the recommended 16 AP experiments. These experiments are indicated by the letters "AP" in parentheses after the lab titles. We recommend that AP Chemistry teachers purchase both of these books. For a complete correlation of Vernier labs with AP Chemistry lab objectives, visit **www.vernier.com/ap**

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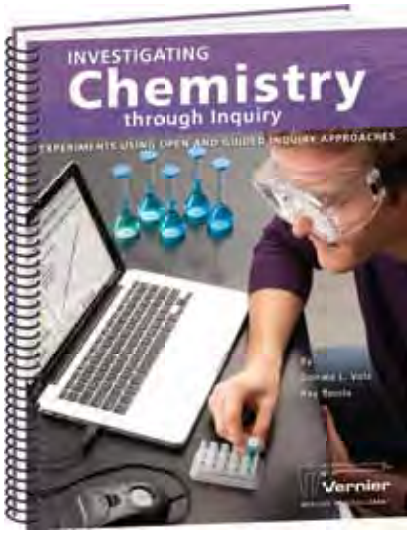


CHEMISTRY INQUIRY LAB BOOK

$48 ORDER CODE **CHEM-I** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- 25 inquiry-based, chemistry investigations.
- Essential teacher information for successful inquiry investigations.
- Suggested researchable questions, sample data, and graphs.
- A generous site license. Buy one book and duplicate the labs for your class.
- Microsoft® Word® files on CD for the experiments so you can easily edit labs to meet your personal teaching style.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/chem-i**

Investigating Chemistry through Inquiry lab book contains the following investigations:

USING A TEMPERATURE PROBE
- Physical Properties of Water
- Baking Soda and Vinegar Investigations
- An Investigation of Urea-Containing Cold Packs **(AP)**
- Identifying a Pure Substance **(AP)**
- Investigating the Energy Content of Foods
- Investigating the Energy Content of Fuels
- Evaporation and Intermolecular Attractions
- Enthalpy Changes
- Reaction Stoichiometry
- Colligative Properties of Solutions
- Long Term Water Monitoring
- Vapor Pressure and Heat of Vaporization Investigations
- The Effect of Acid Deposition on Aqueous Systems **(AP)**
- Baking Soda and Vinegar Investigations Revisited **(AP)**
- Reaction Rates **(AP)**
- Enzyme Activity
- Sugar Fermentation by Yeast

USING A GAS PRESSURE SENSOR
- Vapor Pressure and Heat of Vaporization Investigations
- Baking Soda and Vinegar Investigations Revisited **(AP)**
- Reaction Rates **(AP)**
- Enzyme Activity
- Sugar Fermentation by Yeast

USING A pH SENSOR
- Long Term Water Monitoring
- Acid-Base Properties of Household Products **(AP)**
- The Effect of Acid Deposition on Aqueous Systems **(AP)**
- Acid-Base Titrations **(AP)**
- Baking Soda and Vinegar Investigations Revisited **(AP)**

USING A VOLTAGE PROBE
- Investigating Voltaic Cells

USING A CONDUCTIVITY SENSOR
- Conductivity of Aqueous Solutions **(AP)**
- Long Term Water Monitoring
- Conductimetric Titrations

USING A COLORIMETER OR SPECTROVIS PLUS
- Beer's Law Investigations **(AP)**

USING AN ORP SENSOR
- Oxidation-Reduction Titrations **(AP)**

USING A RADIATION MONITOR
- Nuclear Radiation

VIDEO ONLINE

Chemistry Inquiry LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS		CODE	Colorimeter Deluxe **LQ2-CMI-DX**	SpectroVis Plus Deluxe **LQ2-CMI-SV**
Vernier LabQuest 2 Interface		**LABQ2**	$329	$329
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
pH Sensor		PH-BTA	$79	$79
Gas Pressure Sensor		GPS-BTA	$83	$83
Conductivity Probe		CON-BTA	$95	$95
Drop Counter		VDC-BTD	$99	$99
ORP Sensor		ORP-BTA	$79	$79
CHOOSE ONE	**Colorimeter** or	COL-BTA	$115	—
	SpectroVis Plus Spectrophotometer	SVIS-PL	—	$459
PACKAGE PRICE			**$908**	**$1,252**

YOU WILL ALSO NEED:

Investigating Chemistry through Inquiry **lab book** ORDER CODE **CHEM-I, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFERS: BUY 8 **COLORIMETER** PACKAGES AT $881 EACH AND **SAVE $216!** | BUY 8 **SPECTROVIS PLUS** PACKAGES AT $1,214 EACH AND **SAVE $304!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS		CODE	Colorimeter Deluxe **LM-CMI-DX**	SpectroVis Plus Deluxe **LM-CMI-SV**
Vernier LabQuest Mini Interface		**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
pH Sensor		PH-BTA	$79	$79
Gas Pressure Sensor		GPS-BTA	$83	$83
Conductivity Probe		CON-BTA	$95	$95
Drop Counter		VDC-BTD	$99	$99
ORP Sensor		ORP-BTA	$79	$79
CHOOSE ONE	**Colorimeter** or	COL-BTA	$115	—
	SpectroVis Plus Spectrophotometer	SVIS-PL	—	$459
PACKAGE PRICE			**$728**	**$1,072**

YOU WILL ALSO NEED:

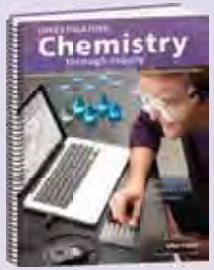
Investigating Chemistry through Inquiry **lab book** ORDER CODE **CHEM-I, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFERS: BUY 8 **COLORIMETER** PACKAGES AT $706 EACH AND **SAVE $176!** | BUY 8 **SPECTROVIS PLUS** PACKAGES AT $1,040 EACH AND **SAVE $256!**

STARTER PACKAGES for chemistry inquiry are available online at www.vernier.com/packages/inquiry-chemistry

WE ALSO RECOMMEND:



Investigating Chemistry through Inquiry **lab book**

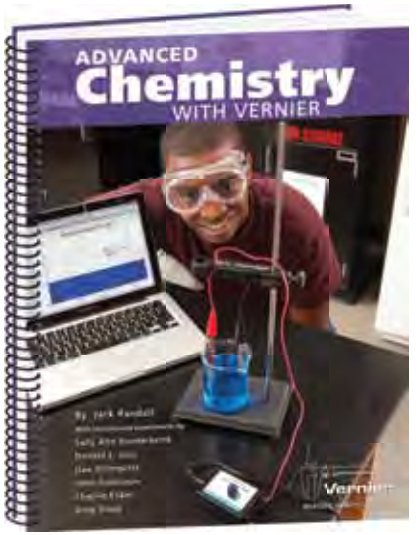
ORDER CODE
CHEM-I
$48

This lab book, reviewed and recommended by NSTA, contains 25 inquiry-based chemistry investigations. If you are new to inquiry-based instruction, the extensive teacher section will help guide you through the inquiry-based style of chemistry instruction.
See page 40.

AP CHEMISTRY TEACHERS

The AP* Chemistry Course Description, revised for 2013, describes 16 laboratory experiments. Many of the experiments in the *Advanced Chemistry with Vernier* and the *Investigating Chemistry through Inquiry* lab books align well with the recommended 16 AP experiments. These experiments are indicated by the letters "AP" in parentheses after the lab titles. We recommend that AP Chemistry teachers purchase both of these books. For a complete correlation of Vernier labs with AP Chemistry lab objectives, visit **www.vernier.com/ap**

*AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.



ADVANCED CHEMISTRY LAB BOOK

$48 ORDER CODE **CHEM-A** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive:

- Essential teacher information, including instructions for preparing solutions.
- 35 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate the labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/chem-a**

Advanced Chemistry with Vernier lab book contains the following experiments:

USING TEMPERATURE PROBES
- Using Freezing-Point Depression to Find Molecular Weight
- The Molecular Mass of a Volatile Liquid
- Molar Volume of a Gas **(AP)**
- Vapor Pressure and Heat of Vaporization
- Rate Determination and Activation Energy
- Synthesis and Analysis of Aspirin **(AP)**
- Exploring the Properties of Gases
- Determining the Mole Ratios in a Chemical Reaction
- Determining the Enthalpy of a Chemical Reaction
- Synthesis and Analysis of Alum
- The Enthalpy of Neutralization of Phosphoric Acid

USING A pH SENSOR
- Standardizing a Solution of Sodium Hydroxide
- Buffers **(AP)**
- Determining the K_{sp} of Calcium Hydroxide
- Determining K_a by the Half Titration of a Weak Acid

USING A COLORIMETER OR SPECTROVIS PLUS
- The Determination of an Equilibrium Constant **(AP)**
- Determining the Concentration of a Solution: Beer's Law **(AP)**
- The Rate and Order of a Chemical Reaction
- The Synthesis and Analysis of Aspirin **(AP)**
- Rate Determination and Activation Energy

USING A pH SENSOR AND DROP COUNTER
- Acid-Base Titration **(AP)**
- Investigating Indicators

USING A VOLTAGE PROBE
- Electrochemistry: Voltaic Cells

USING A GAS PRESSURE SENSOR
- The Decomposition of Hydrogen Peroxide **(AP)**
- The Molar Volume of a Gas **(AP)**
- Exploring the Properties of Gases
- Vapor Pressure and Heat of Vaporization

USING A CONDUCTIVITY PROBE & DROP COUNTER
- Conductimetric Titration and Gravimetric Determination
- The Base Hydrolysis of Ethyl Acetate

USING AN ORP SENSOR & DROP COUNTER
- An Oxidation-Reduction Titration: Fe^{2+} and Ce^{4+} **(AP)**
- Potentiometric Titration of Hydrogen Peroxide **(AP)**

CONSTANT CURRENT SYSTEM
- Electroplating
- Avogadro's Number

USING A RADIATION MONITOR
- Alpha, Beta, and Gamma
- Radiation Shielding
- Half-Life Determination

NO SENSOR USED
- The Determination of a Chemical Formula **(AP)**
- The Determination of the Percent Water in a Compound **(AP)**
- Separation and Qualitative Analysis of Cations **(AP)**
- Liquid Chromatography **(AP)**

VIDEO ONLINE

Advanced Chemistry LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS		CODE	Colorimeter Deluxe **LQ2-CHMA-DLX**	SpectroVis Plus Deluxe **LQ2-CHMA-SV**
Vernier LabQuest 2 Interface		**LABQ2**	$329	$329
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
pH Sensor		PH-BTA	$79	$79
Gas Pressure Sensor		GPS-BTA	$83	$83
Voltage Probe		VP-BTA	$12	$12
Conductivity Probe		CON-BTA	$95	$95
Drop Counter		VDC-BTD	$99	$99
Constant Current System		CCS-BTA	$59	$59
ORP Sensor		ORP-BTA	$79	$79
CHOOSE ONE	**Colorimeter** or	COL-BTA	$115	—
	SpectroVis Plus Spectrophotometer	SVIS-PL	—	$459
PACKAGE PRICE			**$979**	**$1,323**

COLORIMETER DELUXE

SPECTROVIS PLUS DELUXE

YOU WILL ALSO NEED:

Advanced Chemistry with Vernier **lab book**
ORDER CODE **CHEM-A, $48.** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included!
See pp. 18–21 for details.

SPECIAL OFFERS:

BUY 8 **COLORIMETER** PACKAGES AT $950 EACH AND **SAVE $232!**

BUY 8 **SPECTROVIS PLUS** PACKAGES AT $1,283 EACH AND **SAVE $320!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS		CODE	Colorimeter Deluxe **LM-CHMA-DX**	SpectroVis Plus Deluxe **LM-ACSV-DX**
Vernier LabQuest Mini Interface		**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
pH Sensor		PH-BTA	$79	$79
Gas Pressure Sensor		GPS-BTA	$83	$83
Voltage Probe		VP-BTA	$12	$12
Conductivity Probe		CON-BTA	$95	$95
Drop Counter		VDC-BTD	$99	$99
Constant Current System		CCS-BTA	$59	$59
ORP Sensor		ORP-BTA	$79	$79
CHOOSE ONE	**Colorimeter** or	COL-BTA	$115	—
	SpectroVis Plus Spectrophotometer	SVIS-PL	—	$459
PACKAGE PRICE			**$799**	**$1,143**

COLORIMETER DELUXE

SPECTROVIS PLUS DELUXE

YOU WILL ALSO NEED:

Advanced Chemistry with Vernier **lab book**
ORDER CODE **CHEM-A, $48.** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included!
See pp. 18–21 for details.

SPECIAL OFFERS:

BUY 8 **COLORIMETER** PACKAGES AT $775 EACH AND **SAVE $192!**

BUY 8 **SPECTROVIS PLUS** PACKAGES AT $1,109 EACH AND **SAVE $272!**

STARTER PACKAGES for advanced chemistry are available online at www.vernier.com/packages/advanced-chemistry

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. These are Microsoft Word files, so you can edit them for your own organic chemistry lab manual.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 14–15.

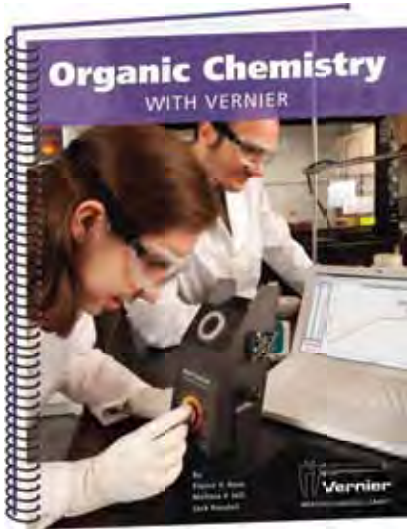
3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended list of sensors for organic chemistry.

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your college department, as well as students' personal computers. See pp. 18–21 for details.

Build custom packages online at www.vernier.com/guide



ORGANIC CHEMISTRY LAB BOOK

$48 ORDER CODE **CHEM-O** GREAT VALUE!

This college-level book makes it easy for organic chemistry instructors to integrate Vernier data-collection technology into the organic chemistry lab curriculum. When you buy the lab book you will receive:

- Complete student experiments with materials list, step-by-step instructions, data tables, and questions.
- Instructor Information section for each experiment with directions for setting up experiments, helpful hints, and sample graphs and data.
- Word-processing files of the student pages on a CD so that any experiment may be easily edited to your specifications (Microsoft® Word® for Macintosh and Windows files).
- Generous site license. Buy one book and duplicate experiments for your class.
- Includes equipment and chemicals list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/chem-o**

Organic Chemistry with Vernier lab book contains the following experiments:

USING A MELT STATION
- Determining Melting Temperature
- Recrystallization of Benzoic Acid and Aspirin
- Identifying an Unknown Analgesic by Melting Temperature and Thin-Layer Chromatography
- Separation of Organic Compounds by Acid-Base Extraction Techniques
- The Synthesis and Analysis of Aspirin
- Synthesis of Dibenzalacetone by Aldol Condensation
- The Diels-Alder Reaction of Anthracene with Maleic Anhydride
- Friedel-Crafts Acylation of Ferrocene

USING A MINI GAS CHROMATOGRAPH
- Fractional Distillation of Esters
- Investigating Gas Chromatography
- Understanding Intermolecular Forces Using a Gas Chromatograph: Enthalpy of Vaporization
- Investigating Thermodynamic Relationships of Substituted Hydrocarbons
- Synthesizing Ethyl Acetate by Fisher Esterification
- Using a Gas Chromatograph: Identifying an Unknown Compound
- S_N1: Synthesis of t-butyl chloride
- S_N2: Synthesis of 1-bromobutane

USING A SPECTROVIS PLUS
- Extraction of Spinach Pigments and Analysis by Electronic Absorption Spectroscopy
- The Synthesis and Analysis of Aspirin
- Grignard Formation of Crystal Violet
- Synthesis of Fluorescein
- Synthesis of Methyl Orange and Its Application to Textiles

USING A POLARIMETER
- Understanding Polarimetry
- Identification of Organic Unknowns Using Polarimetry
- Observing the Reaction Kinetics of Sucrose with Polarimetry
- Isolation and Epoxidation of a Natural Product: Limonene
- Analysis of Natural Products

USING A WIDE-RANGE TEMPERATURE PROBE
- Determination of a Boiling Point: Simple and Fractional Distillation
- Fractional Distillation of Esters
- The Synthesis and Analysis of Aspirin
- Isolation and Epoxidation of a Natural Product: Limonene
- Synthesis of Dibenzalacetone by Aldol Condensation
- The Diels-Alder Reaction of Anthracene with Maleic Anhydride
- Friedel-Crafts Acylation of Ferrocene
- Synthesis of Fluorescein

Products for Organic Chemistry

LabQuest 2 or LabQuest Mini	INTERFACE & SENSORS		CODE	LABQUEST 2	LABQUEST MINI
LabQuest 2 Connected Science System *Standalone or Computer* *Computer Only*	CHOOSE ONE	**LabQuest 2**	**LABQ2**	$329	—
		LabQuest Mini (computer)	**LQ-MINI**	—	$149
	Wide-Range Temperature Probe		WRT-BTA	$79	$79
	Melt Station		MLT-BTA	$449	$449
	Polarimeter (Chemical)		CHEM-POL	$499	$499
	SpectroVis Plus (VIS-NIR spectrometer)		SVIS-PL	$459	$459
	Mini GC Plus		GC2-MINI	$1,799	$1,799
VOLUME DISCOUNTS	CALL US AT **888-837-6437** FOR A PRICE QUOTATION				

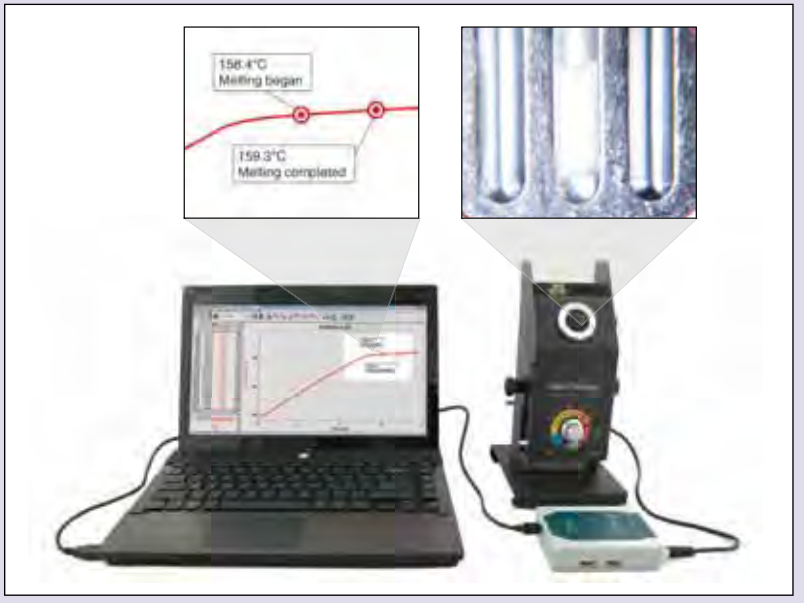
LABQUEST 2

LABQUEST MINI

YOU WILL ALSO NEED:

Organic Chemistry with Vernier **lab book**
ORDER CODE **CHEM-O, $48.** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL department and students' personal computers is included! See pp. 18–21 for details.



Melt Station

Melting Temperature Sensor

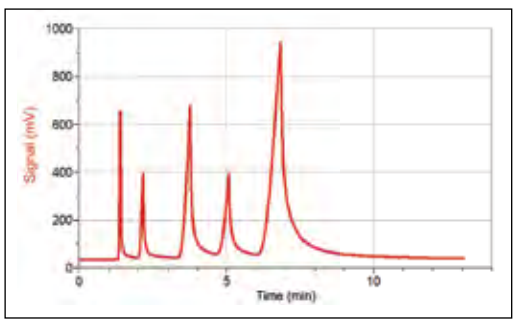
ONLY $449

$449 ORDER CODE **MLT-BTA**

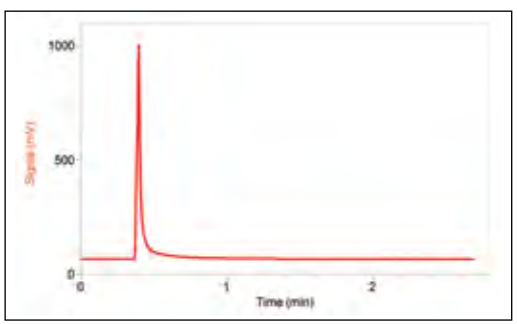
Our Melt Station connects to LabQuest, LabQuest Mini, Go!Link, or LabPro. Use it to measure the melting temperature of solid substances.

- Accurate results using a built-in RTD sensor over a range of 30°C to 260°C
- High-quality 6X viewing lens for clear observation of the samples
- Innovative, adjustable tilt allows for optimal viewing angle
- Cooling fan reduces time between tests

Each Melt Station comes with 100 standard capillary tubes. Additional packages of 100 are available.
ORDER CODE **MLT-TUBE, $15**



Mini GC Plus chromatogram of a ketone mixture



Mini GC Plus chromatogram of 1-chlorobutane

NEW FEATURES

Vernier Mini GC® Plus

$1,799 ORDER CODE **GC2-MINI**

Use Room Air as a Carrier Gas – Our advanced MEMS GC chip technology allows you to use room air as the carrier gas.

Connect to a Computer or LabQuest via USB – Connects to both Windows and Macintosh computers and LabQuest.

Use Our Award-Winning Software for Analysis – With either Logger *Pro* for computers or LabQuest App, peak integration analysis and retention-time determination are built right into the software.

NEW FEATURES OF THE MINI GC PLUS

The Mini GC Plus can detect more compounds than the original Mini GC. The new features that make this possible include:

- The maximum temperature of the column is 160°C, offering more flexibility in designing temperature profiles.
- The MEMS chip sensor can be set at either of two levels of sensitivity.
  - Standard sensitivity mode works well for polar compounds such as ketones, alcohols, and esters.
  - High sensitivity mode works well for compounds such as halogenated alkanes and substituted aromatics, as well as mixtures with one or more compound of low concentration.

Includes Lab Book – Features five experiments suitable for high school or college organic chemistry.

The Mini GC Plus is covered by a two-year warranty (syringe, column, sensor, and septa excluded).

ACCESSORIES

GC Septa (pkg 4)
ORDER CODE **GC-SEP, $25**

GC Syringe, 1 µL Hamilton
ORDER CODE **GC-SYR-MIC, $79**

MORE ONLINE – For more information about the Mini GC Plus, visit **www.vernier.com/gc2-mini**

See training video at **www.vernier.com/videos**

Analyzing ketones using the Vernier Mini GC Plus and a computer running Logger Pro

Analyzing ketones using the Vernier Mini GC Plus and LabQuest 2

Analyzing the optical rotation of sucrose using the Polarimeter and LabQuest 2

CHEMICAL POLARIMETER REQUIREMENTS

The Polarimeter can be used with the following interfaces:

- Vernier LabQuest as a standalone device or with a computer
- Vernier LabQuest Mini with a computer
- Vernier LabPro with a computer
- TI-Nspire Lab Cradle with a TI-Nspire
- Vernier SensorDAQ

The Polarimeter can be used with an interface and the following data-collection software:

- **Logger *Pro*** – This computer program is used with LabQuest, LabQuest Mini, or LabPro. The Polarimeter requires Logger *Pro* 3.8.4.2, or newer.
- **LabQuest App** – This program is used when LabQuest is used as a standalone device. The Polarimeter requires LabQuest App 1.6 or newer.
- **DataQuest** – Use with TI-Nspire technology.
- **LabVIEW** – National Instruments LabVIEW™ software is a graphical programming language produced by National Instruments. It is used with SensorDAQ and can be used with a number of other Vernier interfaces. See **www.vernier.com/labview/**

Chemical Polarimeter

$499 ORDER CODE CHEM-POL

The Chemical Polarimeter is a device used for measuring the rotation of plane-polarized light caused by an optically active substance, such as an organic, inorganic, or biological compound. The Polarimeter can be used to measure chiral properties of optically active samples without chemically modifying or destroying the sample. This is a vertical polarimeter that uses a 589 nm LED, a fixed polarizer, and a manually rotated polarizer to detect changes in rotation of plane-polarized light. Used with Vernier technology, students no longer have to determine the optical maximum by eye, but instead have a graph that shows a clear change in the light's polarization.

Activities and experiments that can be performed using this instrument:

- Determine sugar solution purity by optical rotation
- Characterize the purity of organic and inorganic syntheses yielding chiral products
- Determine the enantiometric purity of optically active compounds
- Resolve racemic mixtures
- Study the kinetics of acid-catalyzed hydrolysis
- Study the kinetics of enzyme-catalyzed hydrolysis
- Explore the optical activity of amino acids

PRODUCT SPECIFICATIONS

Resolution:* 0.25° Light Source: LED Wavelength: 589 nm

* This is the resolution of the analyzer. Typical absolute optical rotation measurements have a repeatability of ±1°.

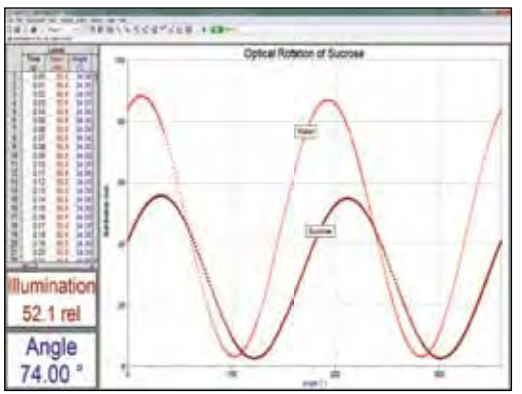
WHAT'S INCLUDED

Chemical Polarimeter, one sample cell, user manual

ACCESSORIES

Polarimeter Sample Cells (ORDER CODE **CELLS-POL**, $66) includes four additional sample cells with screen-printed ruler

MORE ONLINE – Downloadable experiments are available for free online at **www.vernier.com/chem-pol**



Logger Pro *allows easy detection of the optical rotation of compounds like sucrose.*

Spectrometer Accessories

CUVETTES

Plastic Cuvettes package of 100 (visible range), ORDER CODE **CUV, $15**
(Use with V-SPEC, SPRT-VIS, SVIS, and SVIS-PL)

Plastic UV Cuvettes package of 100 (UV-VIS)
ORDER CODE **CUV-UV, $89**
(Use with SPRT-UV-VIS)

Cuvette Rack
ORDER CODE **CUV-RACK, $9**

OPTICAL FIBER

Connects easily to an Ocean Optics or Vernier Spectrometer, 2 m in length, and is used to conduct emission spectrum studies.

VIS-NIR Optical Fiber
ORDER CODE **VIS-NIR, $138**
(Use with V-SPEC, SPRT-VIS, and ESRT-VIS)

UV-VIS Optical Fiber
ORDER CODE **UV-VIS, $138**
(Use with SPRT-UV-VIS)

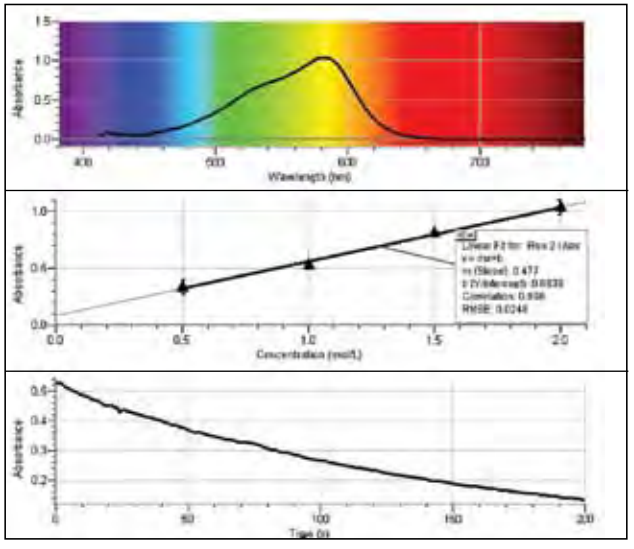
All Ocean Optics spectrometers carry a three-year warranty on the spectrometer and a one-year warranty on the light source.

Ocean Optics™ Spectrometers

	Vernier Spectrophotometer (Ocean Optics powered)	Ocean Optics Red Tide Spectrophotometer	Ocean Optics Red Tide UV-VIS Spectrophotometer
Wavelength Range and Resolution	• 380–950 nm • VIS-NIR • 2 nm between reported values • ~3 nm optical resolution	• 380–950 nm • VIS-NIR • 1 nm between reported values • ~2 nm optical resolution	• 200–850 nm • UV-VIS • 1 nm between reported values • ~2 nm optical resolution
Light Source & Sample Holder	Combination sample holder and LED-boosted tungsten source. The sample holder takes standard 1 cm cuvettes.	Combination sample holder and LED-boosted tungsten source. The sample holder takes standard 1 cm cuvettes.	Combination sample holder and integrated deuterium tungsten halogen light source. The sample holder takes standard 1 cm cuvettes.
Items Included*	• Spectrometer • Light source and cuvette holder • USB cable • 15 plastic cuvettes with lids • Connects by USB to a computer or LabQuest interface; no additional power source needed	• Spectrometer • Light source and cuvette holder • USB cable • 15 plastic cuvettes with lids • Connects by USB to a computer or LabQuest interface; no additional power source needed	• Spectrometer • Light source and cuvette holder • USB cable • 15 UV-VIS cuvettes with lids • Power supply
Price	$1,299 ORDER CODE **V-SPEC***	$1,732 ORDER CODE **SPRT-VIS†***	$2,987 ORDER CODE **SPRT-UV-VIS***

† If you are going to use your Red Tide Spectrometer exclusively for emissions (and not for absorbance and percent transmittance measurements), you can purchase the Red Tide Emissions Spectrometer separately for a lower price. See page 85 for details.
* Software needed: Logger *Pro* or LabQuest App

Examining the absorbance spectrum of copper (II) sulfate using SpectroVis Plus and LabQuest 2



Absorbance spectrum of crystal violet

SpectroVis® Plus

$459 ORDER CODE **SVIS-PL**

An Affordable Spectrophotometer and Fluorometer

Having a CCD array spectrometer/fluorometer combination is now affordable for each of your lab stations! Array spectrometer technology allows you to collect a full wavelength spectrum (absorbance, percent transmittance, or intensity) in less than one second. Once the peak wavelength is determined, you can easily determine the concentration of a solution (Beer's law) or monitor rates of reaction.

Features

- Range: 380–950 nm (VIS-NIR)
- 1 nm between reported values (collects 570 values)
- ~2.5 nm optical resolution
- Support for fluorescence (two excitation sources centered at 405 nm and 500 nm)
- Portable size: 15 cm x 9 cm x 4 cm
- Collect a full spectrum in less than 1 second
- Easy one-step calibration
- Connects directly to LabQuest or to a computer's USB port
- No external power required
- Software required: Logger *Pro* 3.8.2 (or newer) or LabQuest App 1.4 (or newer)

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a. Spectrum Tube Single-Power Supply

ORDER CODE **ST-SPS, $225**

For more information see page 85.

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b. SpectroVis Optical Fiber

ORDER CODE **SVIS-FIBER, $69**

Use the SpectroVis Optical Fiber with a SpectroVis Plus to conduct emission spectrum studies.

WHICH SPECTROMETER IS RIGHT FOR YOU?

It is important to keep in mind all the applications for which you might want to use your spectrometer. We offer spectrometers that measure absorbance, fluorescence, and/or emissions with varying degrees of resolution. To help you decide which one is right for you, see our Spectrometer Comparison Graphs at **www.vernier.com/spectracomparison**

a $225

b $69

a

a. Ohaus Scout™ Pro Balances

It is easy to collect mass data from an Ohaus Scout Pro balance using our popular Logger *Pro* 3 software. Simply connect a Scout Pro balance to your computer's USB or serial port, start the Logger *Pro* software, and collect real-time data as if the Ohaus balance was just another Vernier sensor!

Scout Pro 0.01 g balance (200 g) ORDER CODE **OHSP-202, $329**
Scout Pro 0.01 g balance (400 g) ORDER CODE **OHSP-402, $442**
Scout Pro 0.001 g balance (120 g) ORDER CODE **OHSP-123, $432**

All three balances require:
Scout Pro USB connection kit ORDER CODE **OHSP-USB, $95**

$59 b

b. Instrumentation Amplifier, ORDER CODE INA-BTA, $59

The Instrumentation Amplifier monitors voltages from 20 mV to 1 full scale V (DC or AC). It has several switch settings to allow you to select the best gain. It is typically used to amplify the chart recorder or analog output of any instrument, such as a gas chromatograph.

$179 each c

c. Ion-Selective Electrodes

Great for monitoring four environmentally important ions: Nitrate (NO_3^-), Chloride (Cl^-), Calcium (Ca^{2+}), and Ammonium (NH_4^+). More on page 128.

Nitrate ISE
ORDER CODE **NO3-BTA, $179**

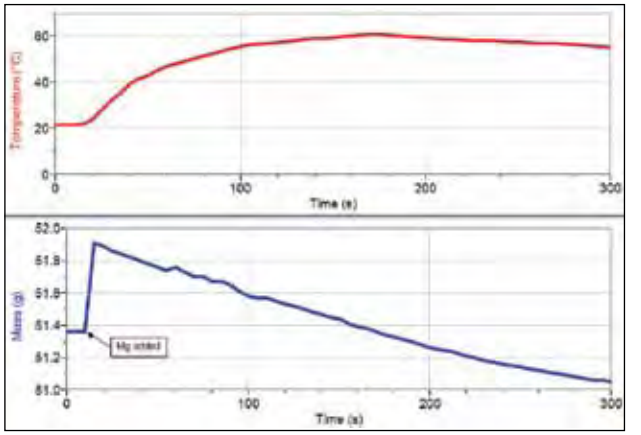
Calcium ISE
ORDER CODE **CA-BTA, $179**

Chloride ISE
ORDER CODE **CL-BTA, $179**

Ammonium ISE
ORDER CODE **NH4-BTA, $179**

NOTE: Ion-Selective Electrodes require good chemical technique and careful calibration to obtain accurate results. They are not recommended for middle school or elementary school students.

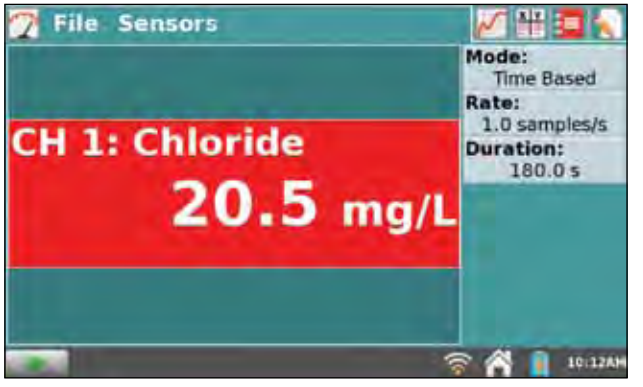
Nitrate, Calcium, and Ammonium ISEs include modules carrying one-year warranties.



Monitoring temperature and mass in the HCl-Mg reaction

Vernier SOFTWARE & TECHNOLOGY & FLINN

Since 1995, Vernier has partnered with Flinn Scientific, the leading provider of chemistry education products, to provide outstanding support for AP Chemistry lab activities.



Testing the chloride ion concentration of pond water

Acid-base titration using a Vernier Drop Counter, pH Sensor, and Stir Station

Did you know?

You can use our Electrode Amplifier with third-party pH electrodes that have BNC connectors or purchase our BNC pH Electrode.

Electrode Amplifier
ORDER CODE **EA-BTA, $40**

BNC pH Electrode*
ORDER CODE **7120B, $41**

* Has a BNC connector to connect to EA-BTA (does not replace PH-BTA)

a. Constant Current System

ORDER CODE **CCS-BTA, $59**

The Constant Current System is a DC power source capable of delivering up to 0.6 A with a built-in current probe designed for use in electrochemistry experiments. You can set the current by turning the dial with the system, automatically adjusting the voltage.

Note: The Constant Current System works only with its own built-in power supply; it cannot be used to measure the current of a circuit using a different power supply.

For sample labs go to **www.vernier.com/ccs-bta**

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b. Stir Station, ORDER CODE STIR, $129

The Stir Station is a high-quality, multi-function magnetic stirrer. It has a stirring capacity of 800 mL in a 1 L beaker. It works efficiently with beakers with a volume as small as 50 mL and with a wide range of sizes and shapes of magnetic stirring bars. Includes Stir Station, Vernier Microstirrer (see page 124), magnetic stirring bar, AC power adapter, and removable ring-stand post. Can be used with AC power or 4 C batteries.

---

c. IMPROVED Electrode Support, ORDER CODE ESUP, $10

Our Electrode Support is even better! We made the original Electrode Support to be a specialized utility clamp for use with many Vernier sensors. The new design includes small, but important, changes. First, the new clamp end makes connecting to ring stands much easier, accommodating post diameters between 0.5 and 1 cm. Second, we added grooves to the Electrode Support to hold the wire leads for electroplating or electrolysis experiments.

---

d. Vernier Drop Counter, ORDER CODE VDC-BTD, $99

The Vernier Drop Counter allows your students to conduct titrations precisely, effectively, and hands-free in less time.

- Vernier chemistry labs are customized for use with our Drop Counter.
- Use with the Vernier pH Sensor for acid-base titrations, Conductivity Probe for conductimetric titrations, and ORP Sensor for oxidation-reduction titrations.

a $59

b $129

- *Three LEDs light up solutions*
- *Can be used with AC power or four C batteries*

c $10

d $99

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 14–15.

3 CHOOSE YOUR SENSORS

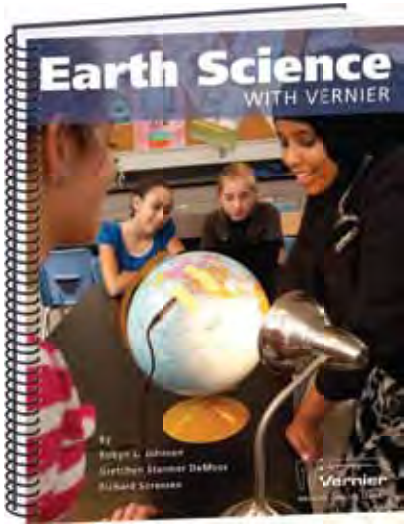
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our Earth science lab book.

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 18–21 for details.

Build custom packages online at www.vernier.com/guide



EARTH SCIENCE LAB BOOK

$48 ORDER CODE **ESV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 33 ready-to-use student versions of Logger *Pro* experiments on hard copy. LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/esv**

Earth Science with Vernier lab book contains the following experiments:

USING A TEMPERATURE PROBE
- Introduction to Data Collection
- Soil Temperature
- Water Quality—Temperature
- Freezing of Ocean Water
- ▶ Reflection and Absorption of Light
- The Greenhouse Effect
- Land and Sea Breezes
- Relative Humidity
- Dew Point
- Wind Chill
- Seasons and Angle of Insolation
- Fossil Fuels
- Solar Homes

USING A LIGHT SENSOR
- ▶ Reflection and Absorption of Light
- Photovoltaic Cells

USING A pH SENSOR
- Soil pH
- Soil and Acid Rain
- Water Quality—pH
- Water Treatment
- Acid Rain and Its Effect on Surface Water

USING A MOTION DETECTOR
- Mapping the Ocean Floor

USING A UVB SENSOR
- Are All Sunglasses Created Equal?
- ▶ Comparing Sunscreens
- UV Light and Clothing

USING A CONDUCTIVITY PROBE
- Soil Salinity
- Water Quality—Total Dissolved Solids
- Water Treatment
- Salinity of Ocean Water
- Desalination

USING A TURBIDITY SENSOR
- Water Quality—Turbidity
- Water Treatment

USING A MAGNETIC FIELD SENSOR
- Exploring Magnetism
- Where IS North?
- Searching for Iron Ore
- Sea Floor Spreading

USING CURRENT AND VOLTAGE PROBES
- Photovoltaic Cells
- Wind Power

STARTER PACKAGES DELUXE PACKAGES ▶ VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Earth Science LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-ES-ST	Deluxe Package LQ2-ES-DX
LabQuest 2 Interface	**LABQ2**	$329	$329
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA	$55	$55
pH Sensor	PH-BTA	$79	$79
UVB Sensor	UVB-BTA	$107	$107
Magnetic Field Sensor	MG-BTA		$58
Conductivity Probe	CON-BTA		$95
Voltage Probe	VP-BTA		$12
Current Probe	DCP-BTA		$39
Turbidity Sensor	TRB-BTA		$112
Motion Detector	MD-BTD		$79
PACKAGE PRICE		**$628**	**$1,023**

YOU WILL ALSO NEED:

Earth Science with Vernier **lab book,** ORDER CODE **ESV, $48**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $992 EACH AND **SAVE $248!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-ES-ST	Deluxe Package LM-ES-DX
LabQuest Mini Interface	**LQ-MINI**	$149	$149
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA	$55	$55
pH Sensor	PH-BTA	$79	$79
UVB Sensor	UVB-BTA	$107	$107
Magnetic Field Sensor	MG-BTA		$58
Conductivity Probe	CON-BTA		$95
Voltage Probe	VP-BTA		$12
Current Probe	DCP-BTA		$39
Turbidity Sensor	TRB-BTA		$112
Motion Detector	MD-BTD		$79
PACKAGE PRICE		**$448**	**$843**

YOU WILL ALSO NEED:

Earth Science with Vernier **lab book,** ORDER CODE **ESV, $48**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $818 EACH AND **SAVE $200!**

Davis Weather Stations

Because they are accurate, economical, easy to use, and well built, Davis Weather Stations are a perfect choice for your school. The Davis Vantage Vue™ weather station is rugged, accurate, reliable, and very affordable. If you want customizable, professional units, the Vantage Pro2 and Vantage Pro2 Plus are excellent choices. All versions are wireless.

For further information about Davis Weather Station products, including computer software and hardware mounting options, see **www.vernier.com/weather**

$395 a

$595 b

a. Vantage Vue™, ORDER CODE DWVUE, $395

The Vantage Vue weather station includes a console with AC power adapter and a self contained, easy-to-install sensor system. The console displays current data along with the ability to view graphs. All without a computer!

The integrated sensor suite combines a rain collector, temperature sensor, humidity sensor, wind direction and anemometer—all in one package. Vantage Vue provides all of the following:

- Barometric pressure
- Rain rate
- Inside and outside humidity
- Rainfall totals
- Inside and outside temperature
- Wind chill
- Wind speed and direction
- Heat index
- Dew point
- Moon phase
- Local forecast
- Time of sunrise and sunset at your location
- Highs and lows for most weather variables

b. Vantage Pro2™, ORDER CODE DWVP, $595

The Vantage Pro2 includes all of the features of Vantage Vue, however, you can add professional features such as a fan-aspirated radiation shield and other sensors.

Vantage Pro2 Plus™, ORDER CODE DWPLUS, $995

The Vantage Pro2 Plus includes all of the features of Vantage Pro2, plus a UV sensor, solar radiation sensor, and a sensor mounting shelf. With the Solar Radiation Sensor, you can also measure evapo-transpiration, solar radiation intensity, and THSW (temperature/humidity/sun/wind) index. The UV Sensor provides UV dose and UV index.

Davis Vantage Vue Console/Receiver

ORDER CODE **DWVUE-CR, $195**

By purchasing additional Vantage Vue Console/Receivers, you can set up multiple monitoring stations in other classrooms throughout your school.

All Davis products carry a one-year warranty.

ESRI Technology CORPORATE ALLIANCE

MAP YOUR DATA USING GIS SOFTWARE FROM ESRI

Map your Vernier data with ArcGIS Explorer, the free virtual globe from ESRI. ArcGIS Explorer can be downloaded at **www.esri.com/arcgisexplorer**

Water quality along Beaverton Creek mapped in ArcGIS Explorer

Anemometer

ORDER CODE **ANM-BTA, $89**

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mount on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

a. Tris-Compatible Flat pH Sensor, ORDER CODE FPH-BTA, $99

The Tris-Compatible Flat pH Sensor uses a double-junction electrode, making it compatible with Tris buffers and solutions containing proteins. The flat glass shape also makes it ideal for measuring the pH of semisolids, such as food or soil.

b. Magnetic Field Sensor, ORDER CODE MG-BTA, $58

Study the magnetic field surrounding various types of magnets.

c. UVA and UVB Sensors

ORDER CODE UVA-BTA, $106, UVB-BTA, $107

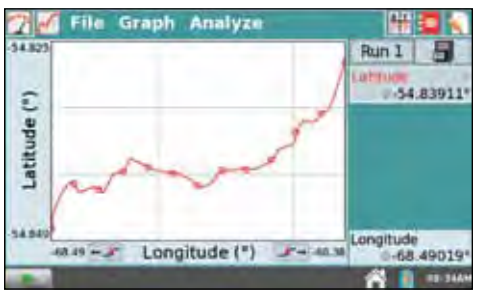
The UVA Sensor is an ultraviolet light sensor that responds primarily to UVA radiation (approximately 320 to 390 nm). This sensor is ideal for experiments using UV lamps.

The UVB Sensor is an ultraviolet light sensor that responds primarily to UVB radiation (approximately 290 to 320 nm). It is ideal for experiments using sunlight as your UV source and is the sensor recommended for the UV experiments in our lab books.

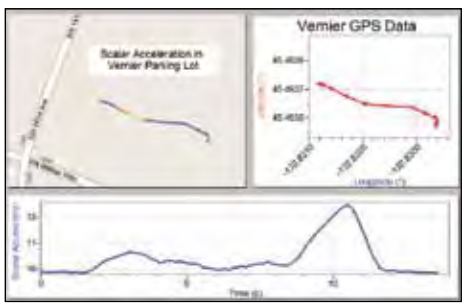
d. NEW Pyranometer, ORDER CODE PYR-BTA, $199

The Pyranometer measures the power of electromagnetic radiation. It is sensitive to near infrared, visible, and UV radiation, where 90% of solar energy is concentrated. It reads in watts per square meter, so it is great for experiments with solar cells and calculating their efficiency.

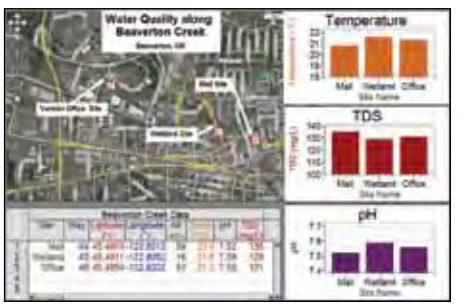
LabQuest showing latitude and longitude



LabQuest graphing the path of a bus ride in Tierra del Fuego



Visually mapping acceleration using Google Maps and Logger Pro



Logger Pro *combines GPS data and water quality sensor data*

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Our two *STEM with Vernier and LEGO MINDSTORMS NXT* lab books contain traditional science experiments, as well as design-and-build robotics projects.

2 ADD THE LEGO NXT INTERFACE & VERNIER NXT ADAPTER

Connect any one of 35 Vernier sensors to the LEGO NXT for science experiments and robotics projects using the Vernier NXT Sensor Adapter. See page 58.

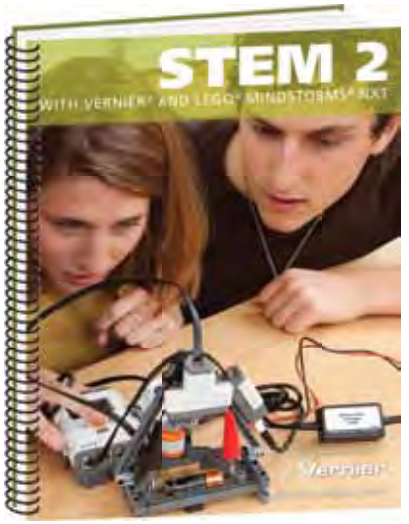
3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

Our STEM and STEM 2 packages contain all the sensors needed to perform every experiment in each lab book.

4 CHOOSE YOUR SOFTWARE

The STEM and STEM 2 lab books assume you are using LEGO MINDSTORMS software. For advanced robotics projects, we recommend using National Instruments LabVIEW™ for Education software.



STEM 2 LAB BOOK

$35 ORDER CODE **STEM2** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive

- Essential teacher information.
- 12 ready-to-use experiments.
- 8 design-and-build robotics projects.
- A generous site license. Buy one book and duplicate labs for your class.
- Microsoft® Word® files for all experiments on CD.
- A CD with MINDSTORMS sample programs, movie clips, and LEGO Digital Designer files.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/stem2**

STEM 2 COVERS CORE TOPICS IN PHYSICAL SCIENCE

STEM 2 with Vernier and LEGO MINDSTORMS NXT lab book contains the following experiments and robotics projects:

USING A DIFFERENTIAL VOLTAGE PROBE

Experiments
- Batteries
- Lemon Battery
- Solar Cells

Projects
- Battery Tester
- Solar Tracker

USING A DUAL-RANGE FORCE SENSOR

Experiments
- Buoyancy
- First-Class Levers
- Friction
- Pulleys

Projects
- Audio Assistant
- String Tension Tester

USING A GAS PRESSURE SENSOR

Experiments
- Gas Pressure
- Grip Strength
- Yeast in Action

Project
- Cartesian Diver

USING A MAGNETIC FIELD SENSOR

Experiments
- Electromagnets
- Mapping a Magnetic Field

Projects
- Magnet Finder
- Migrating Robot
- Mine Sweeper

STEM 2 PHYSICAL SCIENCE PACKAGES | VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Did you know? The STEM and STEM 2 lab books assume you are using the LEGO® MINDSTORMS® Education Base Set and LEGO® MINDSTORMS® Education NXT Software version 2 or newer. Visit **education.lego.com** for more information.

Engineering LEGO NXT Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

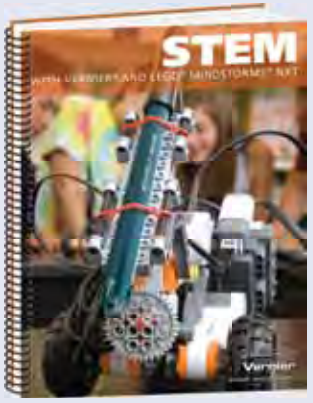
NXT Sensor Adapter	NXT SENSOR ADAPTER & SENSORS	CODE	STEM 2 Physical Science Package **NXT-PS**	STEM Environmental Science Package **NXT-EV**
	Magnetic Field Sensor	MG-BTA	$58	
	Differential Voltage Probe	DVP-BTA	$39	
	Dual-Range Force Sensor	DFS-BTA	$109	
	Gas Pressure Sensor	GPS-BTA	$83	
	NXT Sensor Adapter	**BTA-NXT**	$39	2 @ $39
	Stainless Steel Temperature Probe	TMP-BTA		2 @ $29
	pH Sensor	PH-BTA		$79
	UVB Sensor	UVB-BTA		$107
	Conductivity Probe	CON-BTA		$95
	Soil Moisture Sensor	SMS-BTA		$95
	PACKAGE PRICE		**$328**	**$512**

YOU WILL ALSO NEED:

One or both of our *STEM with Vernier* books.
See below. ORDER CODE **STEM, $35**
See previous page. ORDER CODE **STEM2, $35**

LEGO MINDSTORMS NXT Kit
LEGO® MINDSTORMS® Education NXT Software

SPECIAL OFFER:	BUY 8 **STEM 2** PACKAGES AT $318 EACH AND **SAVE $80!**	BUY 8 **STEM** PACKAGES AT $497 EACH AND **SAVE $120!**



STEM COVERS CORE TOPICS IN ENVIRONMENTAL SCIENCE

ORDER CODE **STEM, $35**

STEM with Vernier and LEGO MINDSTORMS NXT lab book contains the following experiments and robotics projects:

☐ **USING A pH SENSOR**
Experiments
- Household Acids and Bases
- Acid Rain
- Soil pH and Water Absorption
- Water Quality
- A Water Field Study

Projects
- ▶ Acidity Tester
- ▶ Aquarium Monitor

☐ **USING A UVB SENSOR**
Experiments
- UV Light and Clothing
- UV Light and Sunglasses
- Comparing Sunscreens

Project
- ▶ Sunscreen Tester

☐ **USING A TEMPERATURE PROBE**
Experiments
- Heating of Land and Water
- Water Quality
- A Water Field Study
- A Good Sock

Project
- ▶ Aquarium Monitor

☐ **USING A CONDUCTIVITY PROBE**
Experiments
- Water Quality
- A Water Field Study
- Water Hardness
- Ocean Water

☐ **USING A SOIL MOISTURE SENSOR**
Experiments
- Soil Moisture
- Managing Garden Soil Moisture

Project
- ▶ Plant Waterer

▶ VIDEO ONLINE ☐ ENVIRONMENTAL SCIENCE PACKAGE

Look for training videos of some of these labs at **www.vernier.com/videos**

Robotics Videos

Cartesian Diver

This is a robot-controlled version of the classic science demonstration. A LEGO pneumatic pump and a valve are controlled by the robot to adjust pressure. The Vernier Gas Pressure Sensor is used to monitor the pressure.

Solar Tracker

The NXT monitors the output from two solar panels using the Vernier Differential Voltage Probe. The solar panels are mounted on a rotating platform. The robot rotates the platform toward the solar panel with the most light. The net result is that the solar panels follow the sun.

Audio Assistant

This project challenges the students to write a program to indicate the Dual-Range Force Sensor reading with a sound, rather than a number or a graph. The frequency of the sound produced by the NXT is related to the force.

Migrating Robot

This robot uses a Vernier Magnetic Field Sensor to detect the Earth's magnetic field and find north. It then migrates north, much like many animals do in the spring.

Many other robotics videos available at **www.vernier.com/nxt-videos**

SENSORS COMPATIBLE WITH NXT SENSOR ADAPTER

SENSOR	CODE	PRICE	SENSOR	CODE	PRICE
Accelerometers			Instrumentation Amplifier	INA-BTA	$59
25-g Accelerometer	ACC-BTA	$92	Light Sensor	LS-BTA	$55
Low-g Accelerometer	LGA-BTA	$89	Magnetic Field Sensor	MG-BTA	$58
Anemometer	ANM-BTA	$89	O_2 Gas Sensor	O2-BTA	$188
Barometer	BAR-BTA	$71	ORP Sensor	ORP-BTA	$79
Charge Sensor	CRG-BTA	$75	pH Sensor	PH-BTA	$79
Colorimeter	COL-BTA	$115	Relative Humidity Sensor	RH-BTA	$69
Conductivity Probe	CON-BTA	$95	Respiration Monitor Belt *(Requires GPS-BTA)*	RMB	$63
Current Probes			Salinity Sensor	SAL-BTA	$92
Current Probe	DCP-BTA	$39	Soil Moisture Sensor	SMS-BTA	$95
High Current Probe	HCS-BTA	$79	Sound Level Meter	SLM-BTA	$165
Differential Voltage Probe	DVP-BTA	$39	Temperature Sensors		
Dissolved Oxygen Probe	DO-BTA	$209	Stainless Steel Temperature Probe	TMP-BTA	$29
Dual-Range Force Sensor	DFS-BTA	$109	Extra-Long Temperature Probe	TPL-BTA	$79
Electrode Amplifier	EA-BTA	$40	Surface Temperature Sensor	STS-BTA	$23
Flow Rate Sensor	FLO-BTA	$129	Thermocouple	TCA-BTA	$69
Force Plate	FP-BTA	$225	Turbidity Sensor	TRB-BTA	$112
Gas Pressure Sensor	GPS-BTA	$83	UVA Sensor	UVA-BTA	$106
Hand Dynamometer	HD-BTA	$99	UVB Sensor	UVB-BTA	$107

Building a robot that searches for magnets from the* STEM 2 with Vernier and LEGO MINDSTORMS NXT *lab book

Enhance LEGO NXT Robotics

The NXT Sensor Adapter

$39 ORDER CODE **BTA-NXT**

- Connect any one of 35 Vernier sensors to the NXT Intelligent Brick (see above)
- Create sensor-based control systems
- Use with LEGO MINDSTORMS NXT, NI LabVIEW, or ROBOLAB

Students build and test a device to follow the movement of the sun (or flashlight) using a DCU, small DC motor, and two Light Sensors.

Easy Steps for Creating Logger *Pro* Control Applications

Logger *Pro*'s new Digital Output feature makes it easy to create logical statements to control DCU output lines.

1. Select the DCU line or lines you want to activate.
2. Build a logic statement to activate the line when this statement is true.
3. Choose AND, UNTIL, or OR to create a compound statement.

Configuring output logic using the Digital Output feature of Logger Pro

STEM Solutions Using Logger *Pro*

a. Digital Control Unit (DCU)

ORDER CODE **DCU-BTD, $61**

The Digital Control Unit (DCU) gives any Vernier interface with a digital port the ability to perform digital output. Use Logger *Pro* or NI LabVIEW™ software to drive motors, light bulbs, buzzers, or other small electrical devices with up to 600 mA of current. Power supply not included, but you can use either a LabQuest or LabPro power supply (ORDER CODE LQ-PS, $11, or ORDER CODE IPS, $12).

b. Instrumentation Amplifier

ORDER CODE **INA-BTA, $59**

The Vernier Instrumentation Amplifier provides an easy means to connect circuits and devices that produce small voltage signals; a strain-gage bridge circuit is an example. The signal from the strain-gage circuit varies over a few millivolts and the Instrumentation Amplifier steps up this voltage into the range where it can be handled by a Vernier interface.

c. Analog Breadboard Cable

ORDER CODE **BB-BTA, $10**

Digital Breadboard Cable

ORDER CODE **BB-BTD, $11**

The Breadboard Cables provide an easy way to build a custom sensor and input the signal into a Vernier interface using Logger *Pro* software.

One end of the Breadboard Cable plugs into a Vernier interface. The other end plugs into a standard prototyping board. Choose the BB-BTD cable to build custom digital sensors, such as tachometers or photogates. Choose the BB-BTA cable to design your own custom analog sensors, such as photoresistors or thermistors.

a $61

b $59

c

About Project Lead The Way

Project Lead The Way (PLTW) is a leading provider of rigorous and innovative Science, Technology, Engineering, Mathematics (STEM) education curricular programs used in middle and high schools across the U.S.

More than 400,000 students in over 4,700 programs in all 50 states and the District of Columbia are taking PLTW courses. In addition, PLTW has trained more than 10,500 teachers to instruct its engaging, rigorous STEM education curriculum.

Project Lead The Way and Vernier

Over the years, Vernier has developed a strong partnership with Project Lead The Way. We value their mission to prepare students to become the most innovative and productive in the world.

By providing a comprehensive curriculum package based on national standards, focusing on teacher training, and integrating Vernier technology, the PLTW biomedical and engineering programs are extremely valuable for schools integrating hands-on, project-based STEM.

Measuring EMG and muscle fatigue in the PLTW Biomedical Sciences Program

BIOMEDICAL SCIENCES

The PLTW Biomedical Sciences (BMS) Program is a sequence of high school courses, all aligned with appropriate national learning standards, which follows a proven hands-on, real-world, problem-solving approach to learning. Students explore the concepts of human medicine and are introduced to topics such as physiology, genetics, microbiology and public health.

BMS courses complement traditional science courses and can serve as the foundation for STEM-centered or specialized academies. The program is designed to prepare students to pursue a post-secondary education and careers in the biomedical sciences.

PATHWAY TO ENGINEERING

PLTW's Pathway To Engineering (PTE) curriculum is designed to span all four years of high school. Courses are centered on activities that are hands-on and project-based. Students explore engineering topics such as aerodynamics, biomechanics, manufacturing and alternative energy; and apply math, science, and engineering concepts using a design process to solve real-world problems.

MORE ONLINE – For more information, visit **www.pltw.org**

National Instruments LabVIEW™ for Education Software

Graphical Programming Language for High School STEM Education

The National Instruments LabVIEW for Education software helps teachers bring STEM concepts to life through hands-on learning. This is industry-standard LabVIEW (used throughout the engineering disciplines) refined for classroom use, with modules for educational hardware, including these Vernier products:

- LabQuest/LabQuest 2
- LabQuest Mini
- SensorDAQ
- NXT Sensor Adapter
- Go! devices (Go!Link, Go!Temp, Go!Motion)

Full integration means that everything required for these Vernier products is included. Install NI LabVIEW for Education, connect the Vernier hardware, and begin running examples to:

- Log and analyze data
- Introduce engineering measurement and automation concepts
- Build sensor-controlled NXT robots
- Perform feedback and control
- Introduce biomedical concepts with physiology sensors

Single-User NI LabVIEW for Education, ORDER CODE **LV4E-1, $129**
10-User NI LabVIEW for Education, ORDER CODE **LV4E-10, $799**
LabVIEW for Education Site License, ORDER CODE **LV4E-SITE, $1,499**
Windows and Macintosh versions are included. For more information, go to **www.vernier.com/labview**

License available to U.S. high schools only. NI LabVIEW for use outside the U.S., in colleges and universities, or for individual use, should be purchased from National Instruments at **ni.com/academic**

VERNIER LABVIEW DOWNLOADS

We have drivers and sample code to help you write LabVIEW programs for all of the products below. To download LabVIEW examples for these interfaces, go to **www.vernier.com/labview/downloads/**

LabQuest 2

SensorDAQ

SpectroVis Plus

Go! devices

NXT Sensor Adapter

LabQuest Mini

WDSS

Davis Weather Stations

NI ELVIS

LabPro

Mini GC Plus

SensorDAQ—Designed by NI & Vernier for Engineering Education

Perfect for teaching NI LabVIEW or for building sensor-controlled student projects using NI LabVIEW software

SensorDAQ, a joint project of National Instruments and Vernier, is a USB data-acquisition interface that offers convenience and power to engineering students.

- Connect 68 Vernier sensors
- Compatible with any Vernier analog or digital sensor. Go to **www.vernier.com/sdaq**
- Use with NI LabVIEW software version 2009 or newer (not included)
- Windows only

Not compatible with Logger Pro *or Logger Lite software*

$189 ORDER CODE SDAQ

Includes: SensorDAQ, Voltage Probe, USB cable, user manual, and sample programs. SensorDAQ carries a one-year warranty.

Screw Terminal
Build circuits, control motors, create custom sensors, and more
- 2 analog input
- 4 digital I/O
- 1 analog output
- 1 counter/pulse generator

1 Digital Sensor Channel
Connect any Vernier digital sensor

3 Analog Sensor Channels
Connect any Vernier analog sensor

Fast Sampling Rate
Up to 48,000 samples per second

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Learn how to program with NI LabVIEW with our *Hands-On Introduction to NI LabVIEW* book. Then, take your LabVIEW programming to the next level with the *Engineering Projects with NI LabVIEW and Vernier* book.

2 CHOOSE YOUR INTERFACE

We recommend the SensorDAQ as our Engineering interface to use with NI LabVIEW software.

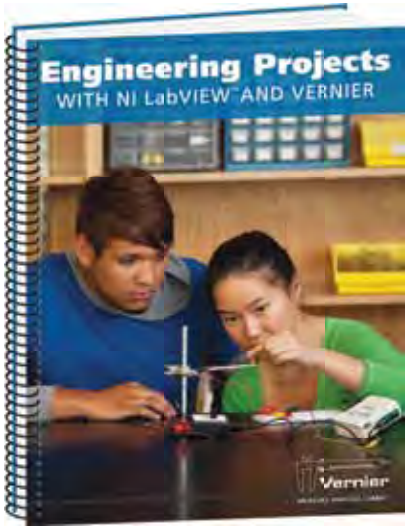
LabQuest and LabQuest Mini can also be programmed with NI LabVIEW and are supported by the Engineering lab books.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

4 ADD A COPY OF NI LABVIEW™ SOFTWARE

We recommend NI LabVIEW for Education, which introduces students to a powerful engineering software. See page 61 for details.



ENGINEERING PROJECTS BOOK

$48 ORDER CODE **EPV** GREAT VALUE!

This lab book contains engaging hands-on projects for SensorDAQ, LabQuest, or LabQuest Mini. It introduces engineering concepts and programming with NI LabVIEW development software. An introductory knowledge of NI LabVIEW programming is assumed (see our *Hands-On Introduction to NI LabVIEW* book). When you buy the lab book, you will receive:

- Essential teacher information
- 12 projects with challenge exercises
- A generous site license. Buy one book and duplicate labs for your class.
- Microsoft® Word® files for all experiments and teacher files on CD. Easily modify these files to meet your personal teaching style.
- NI LabVIEW sample programs on CD for each project and challenge.

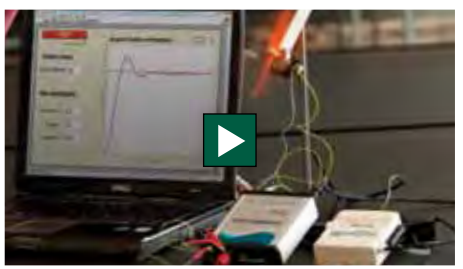
The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/epv**

Engineering Projects with NI LabVIEW and Vernier contains the following projects:

☐ ■ Build a Temperature Sensor	■ DC Motor Control	■ Blood Pressure
☐ ■ Digital Control Systems	☐ ■ Light Intensity	☐ ■ Strain Gage Measurement
☐ ■ 3-Color LED	■ Servo Motor	■ Propeller Control
☐ ■ Hot Wire Anemometer	☐ ■ EKG	■ Ping-Pong Ball Levitation

☐ STARTER PACKAGES ■ DELUXE PACKAGES



A GREAT WAY TO TEACH STEM

This book introduces many important science and engineering concepts, including analog and digital input, sensors and how they are calibrated, feedback and control, analog and digital output, servo and stepper motors, PID control, pulse-width modulation, voltage dividers, and Wheatstone bridges.

Videos of many of these projects are available at **www.vernier.com/training/videos/?product=epv**

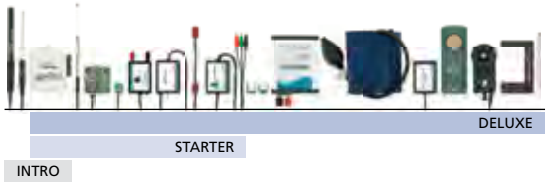
Engineering NI LabVIEW Packages

Purchase one package per lab group (2–4 students).

SensorDAQ

*Packages are also available with LabQuest 2 and LabQuest Mini. See **www.vernier.com/engpkg***

SENSORDAQ AND SENSORS	CODE	Intro to NI LabVIEW Package **SD-EE**	Engineering Projects with NI LabVIEW Starter **SD-EP-ST**	Engineering Projects with NI LabVIEW Deluxe **SD-EP-DX**
Microphone	MCA-BTA	$39	—	—
Stainless Steel Temperature Probe	TMP-BTA	$29	—	—
SensorDAQ	**SDAQ**	**$189**	**$189**	**$189**
Surface Temperature Sensor	STS-BTA		$23	$23
Digital Control Unit	DCU-BTD		$61	$61
Breadboard Cable	BB-BTA		$10	$10
Instrumentation Amplifier	INA-BTA		$59	$59
Light Sensor	LS-BTA		$55	$55
EKG Sensor	EKG-BTA		$147	$147
Analog Proto Board Connector	BTA-ELV			$10
Digital Proto Board Connector	BTD-ELV			$10
Power Amplifier	PAMP			$199
Blood Pressure Sensor	BPS-BTA			$105
Motion Detector	MD-BTD			$79
Rotary Motion Sensor	RMV-BTD			$169
Photogate	VPG-BTD			$45
PACKAGE PRICE		**$257**	**$544**	**$1,161**
SPECIAL OFFER:	BUY 8 OR MORE PACKAGES AT $249 EACH AND SAVE **$64**			BUY 8 OR MORE DELUXE PACKAGES AT $1,126 EACH AND SAVE **$280**



YOU WILL ALSO NEED:

- **LabVIEW for Education Software** (one per seat)
  ORDER CODE **LV4E-1, $129** (single user), or
  ORDER CODE **LV4E-10, $799** (10 users), or
  ORDER CODE **LV4E-SITE, $1,499** (site license)
- One or both Engineering lab books:
  - ***Hands-On Introduction to NI LabVIEW™ with Vernier,*** ORDER CODE **LWV, $25**
  - ***Engineering Projects with NI LabVIEW™ and Vernier,*** ORDER CODE **EPV, $48**

HANDS-ON INTRODUCTION TO NI LABVIEW™ WITH VERNIER LAB BOOK

ORDER CODE **LWV, $25**

This book introduces NI LabVIEW programming through a series of hands-on exercises using Vernier sensors and SensorDAQ, LabQuest, or LabQuest Mini. All of these chapters can be completed with the SD-EE package. Contents include:

Getting Started
- Exercise 1 – Open and Run a LabVIEW Example VI

NI LabVIEW Environment
- Exercise 2 – Read Microphone Data

NI LabVIEW Programming
- Exercise 3 – Read and Analyze Microphone Data

Working with Loops
- Exercise 4 – Continuous Read and Analyze Microphone Data

Presenting Results
- Exercise 5 – Read Temperature Data

Decision Making
- Exercise 6 – Above Threshold Warning of Temperature Data

SubVIs
- Exercise 7 – Create a Temperature Conversion SubVI

SensorDAQ Automation*
- Exercise 8 – Control Analog Out, Digital Out, and Pulse Out

Projects
- Output a tone from your computer proportional to a sensor reading.
- Display what key is pressed on a cell phone by analyzing the frequency of the tone.

* Can only be done with SensorDAQ

1 IT ALL STARTS WITH CURRICULUM

Looking to introduce inquiry into your curriculum? Start with a Vernier lab book. Aligned to state and national science standards, our lab book contains environmental science inquiry investigations.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

3 CHOOSE YOUR SENSORS

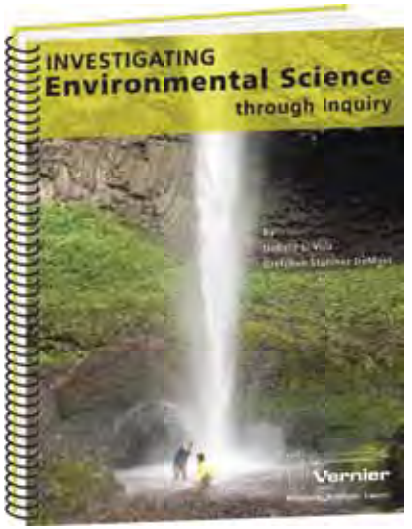
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our environmental science lab book.

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 18–21 for details.

Build custom packages online at www.vernier.com/guide



ENVIRONMENTAL SCIENCE LAB BOOK

$48 ORDER CODE **ESI** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- 34 inquiry-based, environmental science investigations.
- Essential teacher information for successful inquiry investigations.
- Suggested researchable questions, sample data, and graphs.
- A generous site license. Buy one book and duplicate labs for your class.
- Microsoft® Word® files on CD for the experiments so you can easily edit labs to meet your personal teaching style.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/esi**

Investigating Environmental Science through Inquiry lab book contains the following inquiry experiments:

USING A TEMPERATURE PROBE
- Seasons and Angle of Insolation
- A Local Weather Study
- Water Quality
- Long Term Water Monitoring
- Soil Temperature
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Ecocolumn Investigations
- Global Warming
- Insulation Study
- Fossil Fuel Energy
- Energy Conversion
- An Investigation of Passive Solar Heating
- A Pollution Study

USING A TURBIDITY SENSOR
- Water Quality
- Long Term Water Monitoring
- Water Treatment
- Population Dynamics
- A Pollution Study

USING A pH SENSOR
- Water Quality
- Long Term Water Monitoring
- Water Treatment
- Soil pH
- Soil and Acid Precipitation
- Water Cycle Column Investigations
- Decomposition Column Investigations
- The Effect of Acid Deposition on Aquatic Ecosystems
- A Pollution Study
- Ecocolumn Investigations

USING A CONDUCTIVITY SENSOR
- Water Quality
- Long Term Water Monitoring
- Water Treatment
- Investigating Salinity
- Soil Salinity
- Water Cycle Column Investigations
- Ecocolumn Investigations
- The Effect of Acid Deposition on Aquatic Ecosystems

USING A SOIL MOISTURE SENSOR
- Soil Moisture
- Managing Garden Soil Moisture
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Ecocolumn Investigations
- A Pollution Study

USING A DISSOLVED OXYGEN PROBE
- Investigating Dissolved Oxygen
- Water Quality
- Long Term Water Monitoring
- Biochemical Oxygen Demand
- Primary Productivity
- A Pollution Study

USING A UV SENSOR
- A Local Weather Study
- UV Investigations
- ▶ Comparing Sunscreens

USING A VOLTAGE & CURRENT PROBE
- Wind Power
- Photovoltaic Cells

USING A RELATIVE HUMIDITY SENSOR
- A Local Weather Study
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Ecocolumn Investigations
- A Pollution Study

USING A LIGHT SENSOR
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Ecocolumn Investigations
- Measuring Particulates
- Energy Conversions

USING A CO_2 GAS SENSOR
- ▶ Cell Respiration
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Investigating Indoor Carbon Dioxide Concentrations
- A Pollution Study
- Ecocolumn Investigations

STARTER PACKAGES DELUXE PACKAGES ▶ VIDEO ONLINE

Environmental Science LabQuest 2 Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-EVN-ST	Deluxe Package LQ2-EVN-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
pH Sensor	PH-BTA	$79	$79
Conductivity Probe	CON-BTA	$95	$95
Dissolved Oxygen Probe*	DO-BTA	$209	$209
Soil Moisture Sensor	SMS-BTA	$95	$95
Turbidity Sensor	TRB-BTA	$112	$112
Relative Humidity Sensor	RH-BTA		$69
UVB Sensor	UVB-BTA		$107
CO_2 Gas Sensor	CO2-BTA		$249
Voltage Probe	VP-BTA		$12
Current Probe	DCP-BTA		$39
Light Sensor	LS-BTA		$55
PACKAGE PRICE		**$948**	**$1,479**

DELUXE

STARTER

YOU WILL ALSO NEED:

***Investigating Environmental Science through Inquiry* lab book,** ORDER CODE **ESI, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,435 EACH AND **SAVE $352!**

* Environmental Science Packages containing the new Vernier Optical DO Probe will be available Spring 2013.

AP*/IB† ENVIRONMENTAL SCIENCE

AP Environmental Studies program and the IB Environmental Systems and Societies programs both recommend a strong laboratory and field investigation component. The *Investigating Environmental Science through Inquiry* lab book includes experiments correlated to both AP and IB standards. Environmental topics include:

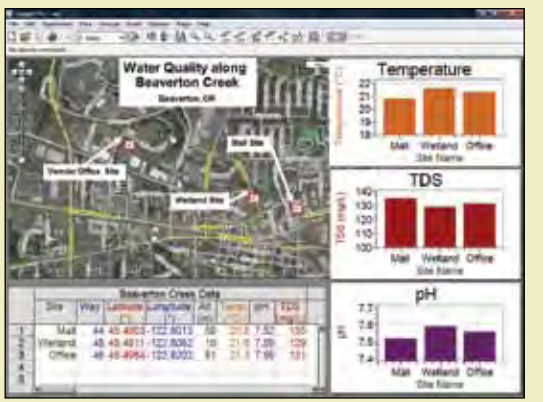
- Earth Systems and Resources—Air and Water
- Earth Systems and Resources—Soil
- The Living World
- Pollution
- Energy Resources and Consumption

MORE ONLINE – For correlations of Vernier labs to AP/IB objectives, visit **www.vernier.com/environmental/**

* AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product. † The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

BUILT-IN GPS

The built-in GPS in LabQuest 2 makes it easier than ever to add location data to your field work. Import the data to Logger *Pro* and then export to Google Maps or GIS software.



Did you know?

All IB Group 4 experimental science courses now require students to use sensors for data logging in an experiment and software for graph plotting.

$109 (a)

$89 (b)

$95 (c)

$64 (d)

NEW
$199 (e)

a. IMPROVED LabQuest Battery Boost 2

ORDER CODE **LQ-BOOST2, $109**

The LabQuest Battery Boost 2 is a rechargeable external battery for your LabQuest or LabQuest 2 interface. With the added power of an external battery, data can be collected for extended periods in the field where AC power is not available.

b. Anemometer, ORDER CODE ANM-BTA, $89

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mount on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

c. Soil Moisture Sensor

ORDER CODE **SMS-BTA, $95**

Simply insert this rugged sensor in soil and the volumetric water content is reported in percent. Use it to conduct experiments in ecology, environmental science, agricultural science, horticulture, biology, and more.

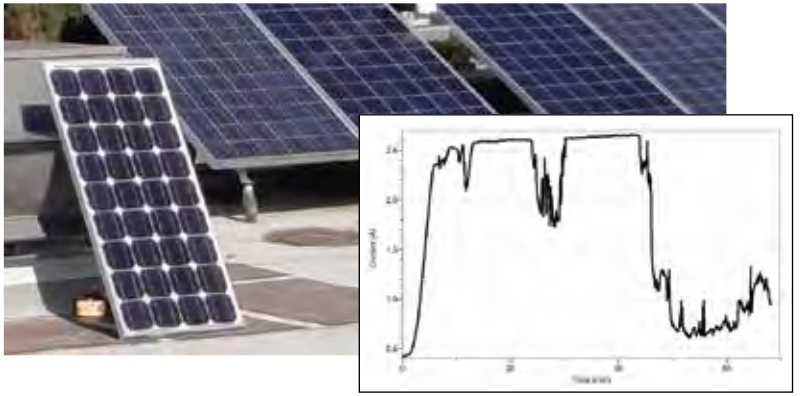
d. Vernier GPS Sensor, ORDER CODE VGPS, $64

The Vernier Global Positioning System (GPS) Sensor collects latitude, longitude, and altitude. If you are using an original LabQuest for data collection, you will need a VGPS sensor to collect location and tracking data. The LabQuest 2 has a built-in GPS.

e. NEW Pyranometer

ORDER CODE **PYR-BTA, $199**

The Pyranometer measures the power of electromagnetic radiation. It is sensitive to near infrared, visible, and UV radiation, where 90% of solar energy is concentrated. It reads in watts per square meter, so it is great for experiments with solar cells and calculating their efficiency.



Current from a solar panel

HIGH CURRENT SENSOR

Do you do experiments with solar panels or other high-current devices? Our High Current Sensor can handle the higher currents from hand-crank generators, large batteries, and solar panels.

The Vernier High Current Sensor has a range of ±10 A. Current is measured with a Hall effect sensor, which uses the magnetic field created by the current. That means that no sense resistor is required, reducing the effect of the sensor on your circuit. A magnetic shield keeps measurements undisturbed by external fields. There's a user-replaceable fuse inside to protect the sensor.

The graph shows the current from a solar panel, which requires the wider range of the High Current Sensor.

For currents below 600 mA, the original Current Sensor (DCP-BTA, $39) is still available and is the better choice for low-current experiments.

30-VOLT VOLTAGE PROBE

We also have a 30-Volt Voltage Probe that's great for using with large solar panels.

$79 ORDER CODE **HCS-BTA**

$49 ORDER CODE **30V-BTA**

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1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 14–15.

Vernier Go!Link – The Go!Link USB interface connects any one of 54 Vernier sensors to your computer. More details on page 16.

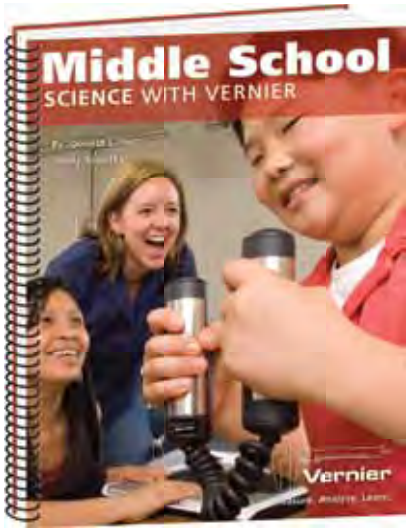
3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our middle school lab book.

4 ADD A COPY OF LOGGER *PRO*

For more advanced users, this award-winning software is the best value around! Includes a site license for all computers in your school, as well as students' personal computers.
See pp. 18–21 for details.



MIDDLE SCHOOL SCIENCE LAB BOOK

$48 ORDER CODE **MSV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive:

- Essential teacher information.
- 38 ready-to-use student versions of computer experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/msv**

Middle School Science with Vernier lab book contains the following experiments:

USING TEMPERATURE PROBES
- A Hot Hand
- Heating of Land and Water
- The Greenhouse Effect
- Relative Humidity
- Absorption of Radiant Energy
- Schoolyard Study
- A Good Sock
- What Causes the Seasons?
- Solar Homes
- Boiling Temperature of Water
- Freezing Temperature of Water
- How Low Can You Go?
- A Good Cold Pack
- A Water Field Study
- Cooling Rates: Shaq *vs.* Susie

USING A pH SENSOR
- Soil Study
- A Water Field Study

USING A VOLTAGE PROBE
- Lemon "Juice"

USING A MOTION DETECTOR
- Ocean Floor Mapping
- Graphing Your Motion
- Velocity
- A Speedy Slide
- The Indy 100
- Crash Dummies
- Falling Objects

USING A LIGHT SENSOR
- Reflectivity of Light
- Schoolyard Study

USING A FORCE SENSOR
- Friction
- First-Class Levers
- Pulleys
- Buoyancy

USING A CONDUCTIVITY PROBE
- Water Hardness Study
- Diffusion: How Fast?
- A Water Field Study

USING A GAS PRESSURE SENSOR
- Get a Grip!
- Fun with Pressure
- Yeast Beasts in Action

USING A HAND-GRIP HEART RATE MONITOR
- Heart Rate and Body Position
- Heart Rate and Exercise

USING A MAGNETIC FIELD SENSOR
- Mapping a Magnetic Field
- Electromagnets

STARTER PACKAGES DELUXE PACKAGES

Look for training videos of some of these labs at **www.vernier.com/videos**

Middle School Science LabQuest 2 and Go!Link Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-MS-ST	Deluxe Package LQ2-MS-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Motion Detector	MD-BTD	$79	$79
pH Sensor	PH-BTA	$79	$79
Voltage Probe	VP-BTA	$12	$12
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA	$55	$55
Dual-Range Force Sensor	DFS-BTA		$109
Gas Pressure Sensor	GPS-BTA		$83
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
Conductivity Probe	CON-BTA		$95
Magnetic Field Sensor	MG-BTA		$58
PACKAGE PRICE		**$612**	**$1,076**

YOU WILL ALSO NEED:

Middle School Science with Vernier **lab book**
ORDER CODE **MSV, $48** See previous page.

Logger Lite software
Free download at **www.vernier.com/logger-lite**

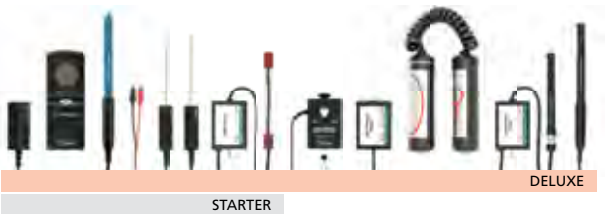
Logger *Pro* 3 software *(optional)*, ORDER CODE **LP, $229**
Buy just one copy—site license for all school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,044 EACH AND **SAVE $256!**

Go!Link

USB Computer Interface

GO!LINK INTERFACE & SENSORS	CODE	Starter Package MSS-GO-STR	Deluxe Package MSS-GO-DX
Vernier Go!Link Interface	**GO-LINK**	$61	$61
Go!Motion	GO-MOT	$109	$109
pH Sensor	PH-BTA	$79	$79
Voltage Probe	VP-BTA	$12	$12
(2) Go!Temp	GO-TEMP	2 @ $39	2 @ $39
Light Sensor	LS-BTA	$55	$55
Dual-Range Force Sensor	DFS-BTA		$109
Gas Pressure Sensor	GPS-BTA		$83
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
Conductivity Probe	CON-BTA		$95
Magnetic Field Sensor	MG-BTA		$58
PACKAGE PRICE		**$394**	**$858**



YOU WILL ALSO NEED:

Middle School Science with Vernier **lab book**
ORDER CODE **MSV, $48** See previous page.

Logger Lite software—included **FREE** with Go! products.

Logger *Pro* 3 software *(optional)*, ORDER CODE **LP, $229**
Buy just one copy—site license for all school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $832 EACH AND **SAVE $208!**

MORE ONLINE – For additional middle school package options, visit www.vernier.com/middle-school

Go!Temp
ORDER CODE **GO-TEMP, $39**

Connect directly to the USB port on your computer to collect temperature data. For more details, see page 17.

Let's Go! Investigating Temperature Lab Book
ORDER CODE **ELB-TEMP, $15**

A collection of ten temperature experiments for computer or LabQuest. These labs are also included in the *Elementary Science with Vernier* book.

Magnetic Field Sensor
ORDER CODE **MG-BTA, $58**

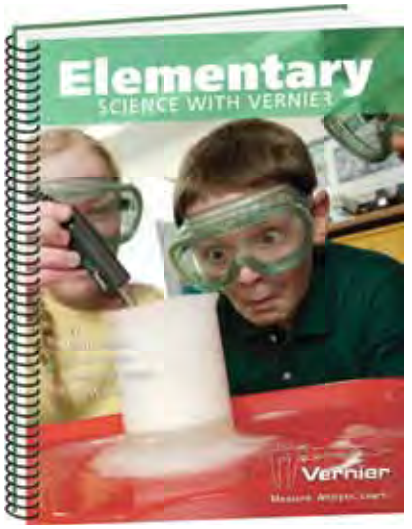
Study the magnetic field surrounding various types of magnets.

Force Plate
ORDER CODE **FP-BTA, $225**

The Force Plate is a large force sensor—tough enough to jump on. Two handles are included for pushing or pulling. For more details, see page 126.

Go!Motion
ORDER CODE **GO-MOT, $109**

Connect directly to the USB port on your computer to collect position, velocity, and acceleration data. For more details, see page 17.



ELEMENTARY SCIENCE LAB BOOK

$48 ORDER CODE **EWV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 43 ready-to-use student version of Logger Lite experiments and one project in print; LabQuest and computer versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Microsoft® Word® files on CD for the experiments so you can easily edit labs to meet your personal teaching style.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/ewv**

Elementary Science with Vernier lab book contains the following experiments:

USING A TEMPERATURE PROBE
- Learning to Use Go!Temp
- How do Mittens Keep You Warm?
- Baggie Mittens
- The Sole Purpose
- Cool Reaction!
- Cold as Ice
- Are We Cool or What?
- Why Do We Need Thermometers?
- Celsius and Fahrenheit, What's the Difference?
- Getting it JUST Right!
- Go!Temp Spends the Night
- Hold Everything! Comparing Insulators
- Keepin' it Cool! Design Your Own Thermos
- I'm Melting! Water Changes States
- Solid, Liquid, Gas: Water Can Do it All!

USING A TI LIGHT PROBE
- Learning to Use the Light Probe
- Distance From the Sun
- Sunshine on My Shoulders
- Summer and Winter
- Reflectivity of Light

USING A MOTION DETECTOR
- Learning to Use Go!Motion
- e-Motion
- Batty About Science
- Spring into Action
- Air Ball!
- Driving with Energy
- Weigh Station: All Trucks Stop!

USING A GAS PRESSURE SENSOR
- Learning to Use the Pressure Sensor
- Get a Grip!
- Under Pressure
- Bubbles in Your Bread

USING A MAGNETIC FIELD SENSOR
- Learning to Use the Magnetic Field Sensor
- Exploring the Poles
- Making Magnets
- Electromagnets

USING A DIFFERENTIAL VOLTAGE PROBE
- Learning to Use the Voltage Probe
- Are All Batteries the Same?
- Stacked Batteries
- All Worn Out!

USING A DUAL-RANGE FORCE SENSOR
- Learning to Use the Force Sensor
- Lift the Load
- What a Drag!
- Oh! My Aching Back! How Ramps Make Lifting Easier

STARTER PACKAGES DELUXE PACKAGES VIDEO ONLINE

Elementary Science LabQuest 2 and Go!Link Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-EL-ST	Deluxe Package LQ2-EL-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
TI Light Probe	TILT-BTA	$13	$13
Motion Detector	MD-BTD	$79	$79
Magnetic Field Sensor	MG-BTA		$58
Gas Pressure Sensor	GPS-BTA		$83
Differential Voltage Probe	DVP-BTA		$39
Dual-Range Force Sensor	DFS-BTA		$109
PACKAGE PRICE		**$450**	**$739**

YOU WILL ALSO NEED:

***Elementary Science with Vernier* lab book**
ORDER CODE **EWV, $48** See previous page.

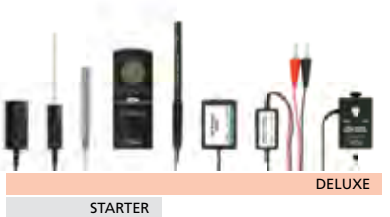
Logger Lite software
Free download at www.vernier.com/logger-lite

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $717 EACH AND **SAVE $176!**

Go!Link

USB Computer Interface

GO!LINK INTERFACE & SENSORS	CODE	Starter Package ELEM-ST	Deluxe Package ELEM-DX
Vernier Go!Link Interface	**GO-LINK**	$61	$61
Go!Link Temperature Probe	GO-TEMP	$39	$39
TI Light Probe	TILT-BTA	$13	$13
Go!Motion - Motion Detector	GO-MOT	$109	$109
Magnetic Field Sensor	MG-BTA		$58
Gas Pressure Sensor	GPS-BTA		$83
Differential Voltage Probe	DVP-BTA		$39
Dual-Range Force Sensor	DFS-BTA		$109
PACKAGE PRICE		**$222**	**$511**



YOU WILL ALSO NEED:

***Elementary Science with Vernier* lab book**
ORDER CODE **EWV, $48** See previous page.

Logger Lite software—included **FREE** with Go! products.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $496 EACH AND **SAVE $120!**

MORE ONLINE – For additional elementary package options, visit www.vernier.com/elementary

1 IT ALL STARTS WITH CURRICULUM

Aligned to state and national math and science standards, this book contains experiments for TI-Nspire technology, TI graphing calculators, and computers.

2 CHOOSE YOUR INTERFACE

For TI-Nspire Technology (handhelds and computer software):

Lab Cradle - For use with TI-Nspire handhelds and computer software. See page 111.

EasyLink - Single-channel sensor interface. See page 114.

For TI Calculators (TI-83/84 Plus, TI-73 Explorer, TI-89 Titanium):

LabPro - Use with TI calculators or computers running our Logger *Pro* software. (Not for use with TI-Nspire) See pp. 108–109.

CBL 2 - Use with TI calculators only. (Not for use with TI-Nspire) See page 114.

EasyLink - TI-84 Plus only (see above)

For computers running Vernier Logger Pro *software:*

LabPro - see above

LabQuest Mini - Use with computers running Logger *Pro* software. See pp. 14–15.

3 CHOOSE OR BUILD YOUR PACKAGE OF SENSORS

Choose from Vernier's recommended packages or build your own.

Build custom packages online at www.vernier.com/guide

MATH ACTIVITY BOOK

$48 ORDER CODE **RWV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive:

- Essential teacher information.
- 32 ready-to-use student versions of TI-Nspire activities in print.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/rwv**

Real-World Math with Vernier: Connecting Math and Science activity book contains the following activities:

☐ **USING A MOTION DETECTOR**
- Straight Line Distance Graphs
- Newton's Second Law*†
- The Linear Force Relation for a Rubber Band*†
- Position and Time for a Cart on a Ramp
- Height and Time for a Bouncing Ball
- Definition of Rate
- Interpreting Velocity Graphs
- Applications of the Distance Formula
- Exponential Pattern of Rebound Heights
- Pendulum Motion
- Damped Harmonic Motion
- Describing Data With Statistical Plots
- Solving a System of Linear Equations
- Plotting an Ellipse
- Parametric Plots
- Piecewise-Defined Functions
- Greatest Integer Functions
- Period and Length of a Simple Pendulum

☐ **USING A LIGHT SENSOR**
- Distance and Intensity
- Periodic Phenomena*

☐ **USING A TEMPERATURE PROBE**
- Mixing Liquids of Different Temperatures
- How Hot Objects Cool
- Describing Data with Statistics*

☐ **USING A VOLTAGE PROBE**
- Exponential Models

☐ **USING A GAS PRESSURE SENSOR**
- Linear Relationship between Water Depth and Pressure
- Linear Rates of Pressure Increase
- The Inverse Relationship between Pressure and Volume

☐ **USING A MICROPHONE**
- Sound Waveform Models*

☐ **USING A FORCE SENSOR**
- Linear Relationship between Weight and Quantity
- Volume and Weight
- Newton's Second Law*
- The Linear Force Relation for a Rubber Band*

☐ **USING A pH SENSOR**
- The Exponential pH Change
- An Application of the Logistic Function

☐ STARTER PACKAGES ☐ DELUXE PACKAGES

* Experiment not supported by Easy Package † Requires Deluxe Package

Logger *Pro* 3

$229 ORDER CODE **LP**

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department. Use Logger *Pro* with the activities in the *Real-World Math with Vernier* book. You can also import data from TI calculators for further analysis on a computer. (This feature not supported with TI-Nspire handhelds.)

Math TI-Nspire Lab Cradle and EasyLink Packages

Purchase one package per group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

TI-Nspire Lab Cradle

TI-Nspire Technology (Handhelds or Computer Software)

TI-NSPIRE LAB CRADLE INTERFACE & SENSORS	CODE	Starter Package LC-MATH-ST	Deluxe Package LC-MATH-DX
TI-Nspire Lab Cradle Interface	**TI-NSLABC**	$145	$145
Motion Detector	MD-BTD	$79	$79
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
TI Light Probe	TILT-BTA	$13	$13
Voltage Probe	VP-BTA	$12	$12
pH Sensor	PH-BTA		$79
Dual-Range Force Sensor	DFS-BTA		$109
Microphone	MCA-BTA		$39
PACKAGE PRICE		**$361**	**$588**
Save when you purchase sets of 5 (Includes Lab Cradle Bundle – see page 111)		**LC-MATH-ST5 $1,775**	**LC-MATH-DX5 $2,876**

YOU WILL ALSO NEED:

Real-World Math with Vernier activity book
ORDER CODE **RWV, $48** See previous page.

TI-Nspire Handheld or computer software. See page 110.

For a complete list of compatible sensors, go to pp. 118–119 or **www.vernier.com/ti-nslabc**

EasyLink

TI-Nspire Handhelds or TI-84 Plus calculators only

EASYLINK INTERFACE & SENSORS	CODE	Starter Package MATH-EZ-STR	Deluxe Package MATH-EZ-DX
Vernier EasyLink Interface	**EZ-LINK**	$59	$59
CBR 2 – Motion Detector	CBR2	$99	$99
EasyTemp Temperature Probe	EZ-TMP	$38	$38
Gas Pressure Sensor	GPS-BTA	$83	$83
TI Light Probe	TILT-BTA	$13	$13
Voltage Probe	VP-BTA	$12	$12
pH Sensor	PH-BTA		$79
Dual-Range Force Sensor	DFS-BTA		$109
PACKAGE PRICE		**$304**	**$492**
SPECIAL OFFER:	BUY 8 DELUXE PACKAGES AT $481 EACH AND **SAVE $88!**		

YOU WILL ALSO NEED:

Real-World Math with Vernier activity book
ORDER CODE **RWV, $48** See previous page.

TI-Nspire Handheld see page 110, or **TI-84 Plus Calculator** see page 115.

For a complete list of compatible sensors, go to pp. 118–119 or **www.vernier.com/easylink**

FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 110–117

MORE ONLINE – For additional math package options, visit www.vernier.com/packages/math

LabPro, ORDER CODE **LABPRO, $220**

For data collection with computers or TI graphing calculators. For more details, see pp. 108–109.

For LabPro packages for math, visit www.vernier.com/products/packages/math/labpro

TI-Nspire Handhelds and Software

Looking for TI-Nspire graphing handhelds and software? See page 110 or visit **www.vernier.com/ti-nspire**

Looking for additional TI products? See pp. 110–117.

TI-SmartView™ Emulator Software, ORDER CODE **TI-SV, $135**

Project an interactive representation of a TI-84 Plus calculator to your entire class.

See page 116 for more details.

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 14–15.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our physical science lab book.

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 18–21 for details.

Build custom packages online at www.vernier.com/guide

PHYSICAL SCIENCE LAB BOOK

$48 ORDER CODE **PSV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 40 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/psv**

Physical Science with Vernier lab book contains the following experiments:

USING A TEMPERATURE PROBE
- Temperature Probe Response Time
- Boiling Temperature of Water
- ▶ Freezing and Melting of Water
- Evaporation of Alcohols
- Endothermic and Exothermic Reactions
- Neutralization Reactions
- Mixing Warm and Cold Water
- Heat of Fusion
- Energy Content of Fuels
- Energy Content of Foods
- Absorption of Radiant Energy
- An Insulated Cola Bottle
- A Good Sock
- Insolation Angle
- Solar Homes and Heat Sinks
- Gas Temperature & Pressure

USING A MOTION DETECTOR
- Velocity
- It's Race Day
- Momentum: A Crash Lesson
- Newton's Second Law
- Graphing Your Motion
- Falling Objects

USING A pH SENSOR
- Household Acids and Bases
- Acid Rain

USING A VOLTAGE PROBE
- Lemon "Juice"
- Lead Storage Batteries

USING A FORCE SENSOR
- Frictional Forces
- First-Class Levers
- Pulleys
- ▶ An Inclined Plane

USING A LIGHT SENSOR
- ▶ Reflectivity of Light
- Polaroid Filters
- How Bright is the Light?

MAGNETIC FIELD SENSOR
- Electromagnets: Winding Things Up
- Magnetic Field Explorations

USING A CONDUCTIVITY PROBE
- Conducting Solutions
- Conductivity of Salt Water
- Acid Strengths
- Neutralization Reactions

USING A GAS PRESSURE SENSOR
- Gas Pressure and Volume
- Gas Temperature and Pressure
- Fun with Pressure

☐ STARTER PACKAGES ■ DELUXE PACKAGES ▶ VIDEO ONLINE

Interested in Middle School Science? See pp. 68–69.

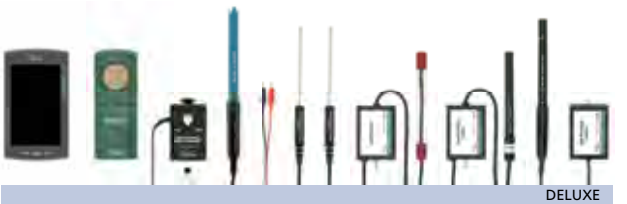
Physical Science LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-PS-ST	Deluxe Package LQ2-PS-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Motion Detector	MD-BTD	$79	$79
Dual-Range Force Sensor	DFS-BTA	$109	$109
pH Sensor	PH-BTA	$79	$79
Voltage Probe	VP-BTA	$12	$12
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA		$55
Conductivity Probe	CON-BTA		$95
Magnetic Field Sensor	MG-BTA		$58
Gas Pressure Sensor	GPS-BTA		$83
PACKAGE PRICE		**$666**	**$957**



YOU WILL ALSO NEED:

Physical Science with Vernier **lab book**
ORDER CODE **PSV, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $928 EACH AND **SAVE $232!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-PS-ST	Deluxe Package LM-PS-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Motion Detector	MD-BTD	$79	$79
Dual-Range Force Sensor	DFS-BTA	$109	$109
pH Sensor	PH-BTA	$79	$79
Voltage Probe	VP-BTA	$12	$12
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA		$55
Conductivity Probe	CON-BTA		$95
Magnetic Field Sensor	MG-BTA		$58
Gas Pressure Sensor	GPS-BTA		$83
PACKAGE PRICE		**$486**	**$777**

YOU WILL ALSO NEED:

Physical Science with Vernier **lab book**
ORDER CODE **PSV, $48** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $754 EACH AND **SAVE $184!**

$79 a

$55 b

$12 c

a. Motion Detector, ORDER CODE MD-BTD, $79

The Motion Detector can be used to study the motion of a cart on a ramp or a ball tossed into the air. You can also use it to teach your students how graphs work by having them try to move in front of the motion detector to match a distance *vs.* time or velocity *vs.* time graph.

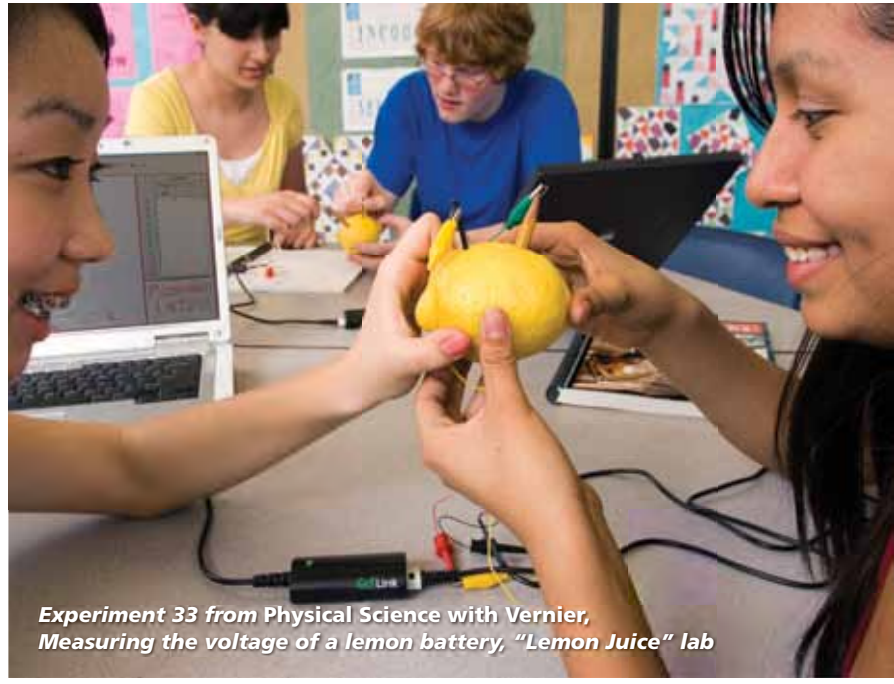
- Measure objects as close as 15 cm to the detector and as far away as 6 m.
- Pivoting head and rubber feet for ease of use

b. Light Sensor, ORDER CODE LS-BTA, $55

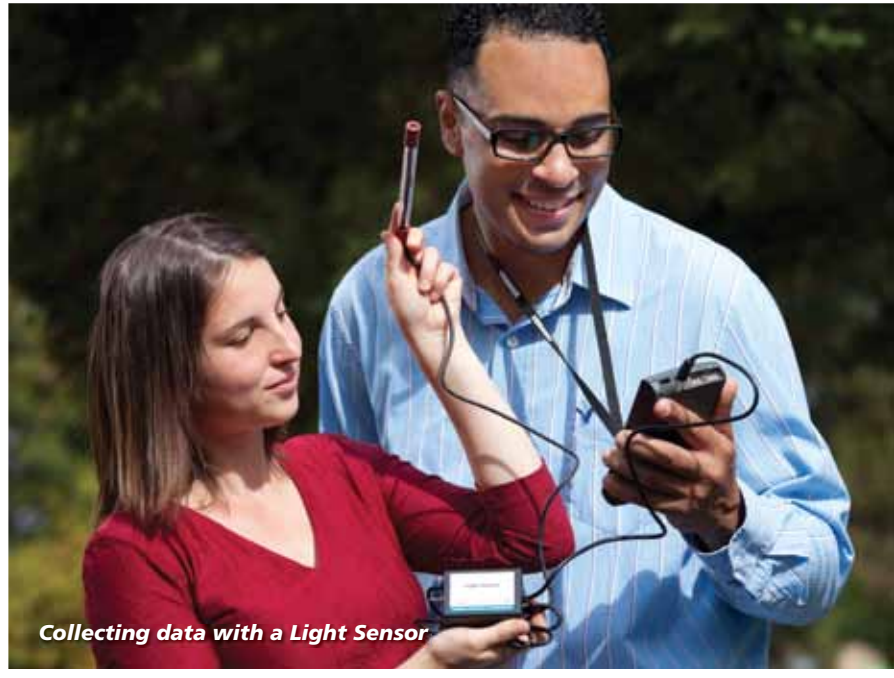
Our Light Sensor approximates the human eye in spectral response and can be used over three different illumination ranges, which you select with a switch. Use it for inverse square law experiments or for studying polarizers, reflectivity, or solar energy.

c. Voltage Probe, ORDER CODE VP-BTA, $12

The Voltage Probe can be used to study voltages produced by simple voltaic cells (like the lemon battery, top right), for simple electric circuit labs, or to do battery life studies.



Experiment 33 from* Physical Science with Vernier, *Measuring the voltage of a lemon battery, "Lemon Juice" lab



Collecting data with a Light Sensor

Studying dynamics with Vernier LabQuest 2

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1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 14–15.

Vernier LabPro – LabPro works with computers or TI calculators. For information on data collection with TI graphing calculators, see pp. 108–109.

3 CHOOSE YOUR SENSORS

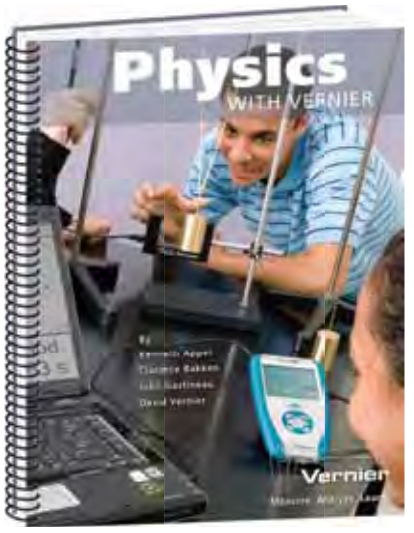
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our physics lab book.

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 18–21 for details.

Build custom packages online at www.vernier.com/guide



PHYSICS LAB BOOK

$48 ORDER CODE **PWV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive:

- Essential teacher information.
- 35 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at www.vernier.com/pwv

Physics with Vernier lab book contains the following experiments:

USING A MOTION DETECTOR
- Graph Matching
- Cart on a Ramp
- Determining *g* on an Incline
- Ball Toss
- Air Resistance
- Simple Harmonic Motion
- Energy of a Tossed Ball
- Energy in Simple Harmonic Motion
- Momentum, Energy and Collisions
- Impulse and Momentum
- Back and Forth Motion

USING A FORCE SENSOR
- Newton's Second Law
- Newton's Third Law
- Static and Kinetic Friction
- Impulse and Momentum

USING A MICROPHONE
- Sound Waves and Beats
- Tones, Vowels and Telephones
- Mathematics of Music
- Speed of Sound

USING A VOLTAGE PROBE
- Capacitors

USING PHOTOGATES
- Picket Fence Free Fall
- Projectile Motion
- Atwood's Machine
- Pendulum Periods

USING A TEMPERATURE PROBE
- Newton's Law of Cooling

USING AN ACCELEROMETER
- Bungee Jump Accelerations
- Centripetal Accelerations on a Turntable
- Accelerations in the Real World
- Newton's Second Law

USING CURRENT & VOLTAGE PROBES
- Ohm's Law
- Series and Parallel Circuits
- Electrical Energy

USING A MAGNETIC FIELD SENSOR
- The Magnetic Field in a Coil
- The Magnetic Field in a Slinky
- The Magnetic Field of a Permanent Magnet

USING A LIGHT SENSOR
- Polarization of Light
- How Light Intensity Varies with Distance

STARTER PACKAGES DELUXE PACKAGES VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Physics LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-PHY-ST	Deluxe Package LQ2-PHY-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Motion Detector	MD-BTD	$79	$79
Dual-Range Force Sensor	DFS-BTA	$109	$109
Microphone	MCA-BTA	$39	$39
Differential Voltage Probe	DVP-BTA	$39	2 @ $39
Low-g Accelerometer	LGA-BTA		$89
Light Sensor	LS-BTA		$55
(2) Vernier Photogates	VPG-BTD		2 @ $45
Ultra Pulley Attachment	SPA		$24
Picket Fence	PF		$7
Stainless Steel Temperature Probe	TMP-BTA		$29
Magnetic Field Sensor	MG-BTA		$58
(2) Current Probes	DCP-BTA		2 @ $39
PACKAGE PRICE		**$595**	**$1,064**

YOU WILL ALSO NEED:

***Physics with Vernier* lab book,** ORDER CODE **PWV, $48**
See previous page.

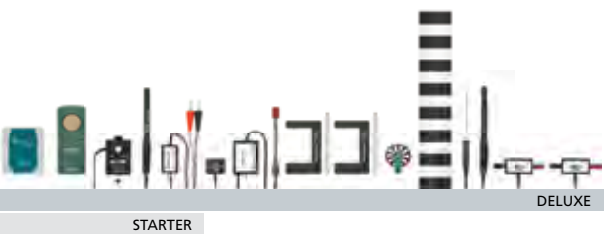
Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for all school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,032 EACH AND **SAVE $256!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-PHY-ST	Deluxe Package LM-PHY-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Motion Detector	MD-BTD	$79	$79
Dual-Range Force Sensor	DFS-BTA	$109	$109
Microphone	MCA-BTA	$39	$39
Differential Voltage Probe	DVP-BTA	$39	2 @ $39
Low-g Accelerometer	LGA-BTA		$89
Light Sensor	LS-BTA		$55
(2) Vernier Photogates	VPG-BTD		2 @ $45
Ultra Pulley Attachment	SPA		$24
Picket Fence	PF		$7
Stainless Steel Temperature Probe	TMP-BTA		$29
Magnetic Field Sensor	MG-BTA		$58
(2) Current Probes	DCP-BTA		2 @ $39
PACKAGE PRICE		**$415**	**$884**



YOU WILL ALSO NEED:

***Physics with Vernier* lab book,** ORDER CODE **PWV, $48**
See previous page.

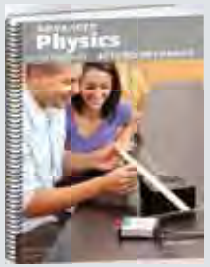
Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for all school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $857 EACH AND **SAVE $216!**

WE ALSO RECOMMEND:

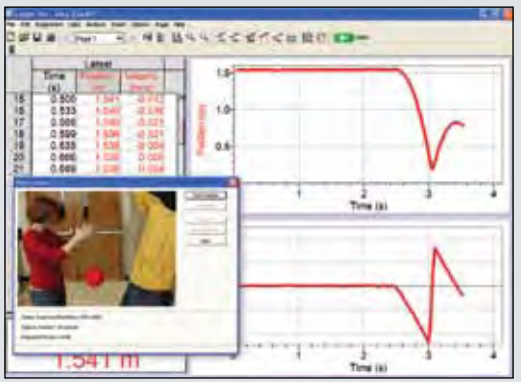
Physics with Video Analysis **lab book**

ORDER CODE
PVA
$48
See page 94.



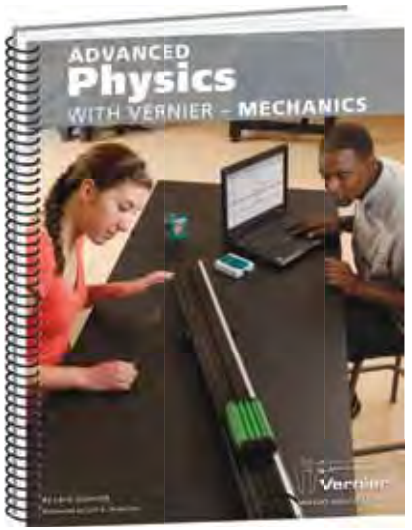
Advanced Physics with Vernier – Beyond Mechanics **lab book**

ORDER CODE
PHYS-ABM
$48
See page 82.



Capture videos and sensor data using Logger Pro *3.*

MORE ONLINE – For FREE sample activities and videos go to **www.vernier.com/experiments/**



ADVANCED PHYSICS: MECHANICS

$48 ORDER CODE **PHYS-AM** GREAT VALUE!

Advanced Physics with Vernier – Mechanics is the first of a two-volume set of experiments for the more in-depth introductory physics course, such as college physics, AP Physics, or IB Physics.

- Experiments are designed for an interactive teaching style, with planned moments for instructor or student-led discussion.
- Instructor notes include discussion on how to lead students to a successful activity.
- Includes many extensions to challenge the most talented students.
- Microsoft® Word® files of student experiments and supporting materials on CD.
- Includes a site license.
- Instructions are written to support data collection in Logger *Pro* or LabQuest App.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/phys-am**

Advanced Physics with Vernier – Mechanics lab book contains the following experiments:

	EXPERIMENT	SENSORS USED	REQUIRED VERNIER ACCESSORIES
1	Motion on an Incline	Motion Detector, Vernier Dynamics System	VDS
2	Error Analysis	Vernier Photogate	PF
3	Newton's First law	Motion Detector	VDS, PAD-VDS, BLK
4	Newton's Second Law	Vernier Photogate, Dual-Range Force Sensor	VDS, BLK, PF-CART, SPA, B-SPA
5	Newton's Third Law	(2) Dual-Range Force Sensors	VDS, BLK
6	Projectile Motion	Video Analysis in Logger *Pro*	
7	Energy Storage and Transfer (Elastic)	Dual-Range Force Sensor	VDS, BLK
8	Energy Storage and Transfer (Kinetic)	Vernier Photogate	VDS, BLK, PF-CART
9	Energy Storage and Transfer (Gravitational)		VDS, BLK
10A	Impulse and Momentum	Motion Detector, Dual-Range Force Sensor	VDS, BLK
10B	Impulse and Momentum	Vernier Photogate, Dual-Range Force Sensor	VDS, PF-CART, BLK
11A	Momentum and Collisions	(2) Motion Detectors	VDS
11B	Momentum and Collisions	(2) Vernier Photogates	VDS, (2) PF-CART
12A	Centripetal Acceleration	Vernier Photogate, Dual-Range Force Sensor	CFA
12B	Centripetal Acceleration	Vernier Photogate, Dual-Range Force Sensor	
13	Rotational Dynamics	Rotary Motion Sensor	AK-RMV
14	Conservation of Angular Momentum	Rotary Motion Sensor	AK-RMV
15	Simple Harmonic Motion - Mathematical Model	Motion Detector	SPRINGS
16	Simple Harmonic Motion - Kinematics and Dynamics	Motion Detector, Dual-Range Force Sensor	SPRINGS
17	Pendulum Periods	Rotary Motion Sensor	AK-RMV
18	Physical Pendulum	Rotary Motion Sensor	AK-RMV
19	Center of Mass	Video Analysis in Logger *Pro*	

Products for Advanced Physics – Mechanics

LabQuest 2 or LabQuest Mini	INTERFACE & SENSORS		CODE	LABQUEST 2	LABQUEST MINI
LABQUEST 2 CONNECTED SCIENCE SYSTEM	CHOOSE ONE	**LabQuest 2**	**LABQ2**	$329	—
		LabQuest Mini (COMPUTER)	**LQ-MINI**	—	$149
	(2) Motion Detectors		MD-BTD	2 @ $79	2 @ $79
	(2) Vernier Photogates		VPG-BTD	2 @ $45	2 @ $45
	(2) Dual-Range Force Sensors		DFS-BTA	2 @ $109	2 @ $109
	Rotary Motion Sensor		RMV-BTD	$169	$169

Standalone or Computer

Computer Only

LABQUEST 2

LABQUEST MINI

YOU WILL ALSO NEED:

Advanced Physics with Vernier – Mechanics **lab book** ORDER CODE **PHYS-AM, $48.** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for all school and students' personal computers is included! See pp. 18–21 for details.

Accessories listed below.

VOLUME DISCOUNTS CALL US AT **888-837-6437** FOR A PRICE QUOTATION

CENTRIPETAL FORCE APPARATUS

$399 ORDER CODE **CFA**

The Centripetal Force Apparatus allows you to investigate the relationship between centripetal force, angular velocity, mass, and radius. A force sensor measures the centripetal force exerted on a mass as it moves in a circle. A photogate can be used to measure the angular speed. Different masses can be added to the platform and positioned at variable radii. The platform can be driven by a falling mass. The apparatus also accommodates the Vernier Wireless Dynamic Sensor System to measure force, which provides the best set of data. Sensors are sold separately.
www.vernier.com/cfa

ADVANCED PHYSICS ACCESSORIES

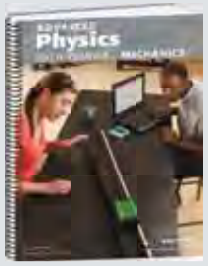
Extensive use is made of these accessories in our *Advanced Physics - Mechanics* lab manual and they are highly recommended. Refer to the list of experiments on the opposite page.

Vernier Dynamics System	VDS	$279
Ultra Pulley Attachment	SPA	$24
Pulley Bracket	B-SPA	$12
Bumper and Launcher Kit	BLK	$89
Cart Friction Pad	PAD-VDS	$30
Picket Fence	PF	$7
(2) Cart Picket Fences	PF-CART	2 @ $6 each
Rotational Motion Accessory Kit	AK-RMV	$110
Centripetal Force Apparatus	CFA	$399
Spring Set	SPRINGS	$16

WE ALSO RECOMMEND:

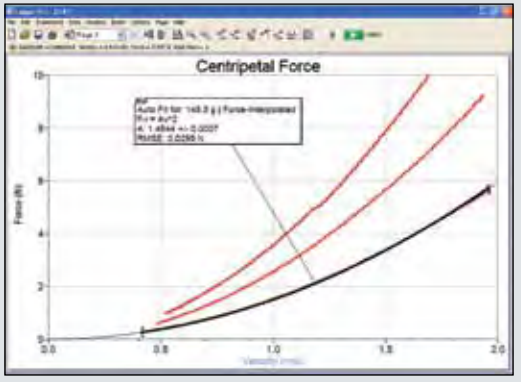
Physics with Video Analysis **lab book**

ORDER CODE
PVA
$48
See page 94.



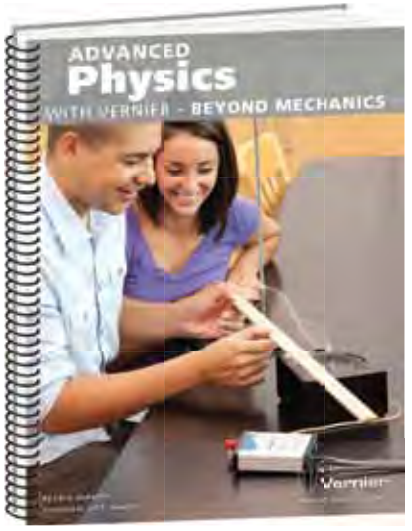
Advanced Physics with Vernier – Mechanics **lab book**

ORDER CODE
PHYS-AM
$48
See page 80.



Centripetal force vs velocity for three different masses, collected using the Vernier Centripetal Force Apparatus

MORE ONLINE – For FREE sample activities and videos go to **www.vernier.com/experiments/**



BEYOND MECHANICS LAB BOOK

$48 ORDER CODE **PHYS-ABM** GREAT VALUE!

Advanced Physics with Vernier – Beyond Mechanics is the second of a two-volume set of experiments for the more in-depth introductory physics course, such as college physics, AP Physics, or IB Physics. Included in this lab book:

- Complete student experiments with a materials list, instructions for data collection on a computer or LabQuest, data tables, and questions.
- Teacher Information section for each experiment with complete directions for setting up experiments, helpful hints, sample graphs, and data.
- Word-processing files of the student sections on a CD so that any experiment may be easily edited to your specifications (Microsoft® Word® files).
- CD includes support material including videos and Logger *Pro* data-analysis files.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/phys-abm**

Advanced Physics with Vernier – Beyond Mechanics lab book contains the following experiments:

EXPERIMENT	SENSORS USED	REQUIRED VERNIER ACCESSORIES
1 Ideal Gas Law	Gas Pressure Sensor, Stainless Steel Temperature	
2 Heat Engines	Gas Pressure Sensor, Stainless Steel Temperature	
3 Standing Waves on a String	Power Amplifier	Power Amplifier Accessory Speaker
4 Standing Waves in a Tube	Microphone	
5 Doppler Effect with Water Waves	No probeware used	
6 Electrostatics	Charge Sensor	Electrostatics Kit
7 Coulomb's law	No probeware used	
8 Field Mapping	Differential Voltage Probe	Power Amp or Power Supply
9 Factors Affecting Resistance	Instrumentation Amplifier, Current Probe†	Power Amp or Power Supply, Resistivity Rod Set
10 Series and Parallel Circuits	Differential Voltage Probe, Current Probe	Vernier Circuit Board
11 Faraday's Law - Moving Magnet	Instrumentation Amplifier	
12 Faraday's Law - Alternating Current	Instrumentation Amplifier	Power Amplifier
13 RC and RL circuits	Differential Voltage Probe, Current Probe	Inductor, Vernier Circuit Board
14 RLC Circuits	Differential Voltage Probe, Current Probe	Power Amplifier, Inductor
15 Mirrors and Real Images		Optics Expansion Kit, Mirror Set*
16 Thin Lenses and Real Images		Optics Expansion Kit*
17 Thin Lenses and Virtual Images		Optics Expansion Kit*
18 Aperture and Depth of Field		Optics Expansion Kit*
19 Diffraction		Diffraction Apparatus
20 Interference		Diffraction Apparatus*
21 Rydberg Constant	Red Tide Emission Spectrometer, Optical Fiber	Emission Tubes
22 Planck's Constant	Differential Voltage Probe	

* These accessories require the Vernier Dynamics System track. (ORDER CODES VDS or TRACK, page 89) † Current Probe needed if using a conventional power supply.

Products for Advanced Physics – Beyond Mechanics

LabQuest 2 or LabQuest Mini	INTERFACE & SENSORS		CODE	LABQUEST 2	LABQUEST MINI
LABQUEST 2 CONNECTED SCIENCE SYSTEM	CHOOSE ONE	**LabQuest 2**	**LABQ2**	$329	—
Standalone or Computer		**LabQuest Mini (computer)**	**LQ-MINI**	—	$149
Computer Only	Gas Pressure Sensor		GPS-BTA	$83	$83
	Stainless Steel Temperature Probe		TMP-BTA	$29	$29
	Power Amplifier		PAMP	$199	$199
	Microphone		MCA-BTA	$39	$39
	Charge Sensor		CRG-BTA	$75	$75
	Differential Voltage Probe		DVP-BTA	$39	$39
	Current Probe		DCP-BTA	$39	$39
	Instrumentation Amplifier		INA-BTA	$59	$59
	Red Tide Emissions Spectrometer		ESRT-VIS	$1154	$1154
	Diffraction Apparatus		DAK	$549	$549
	Optical Fiber		VIS-NIR	$138	$138

SOFTWARE:

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL department and students' personal computers is included! See pp. 18–21 for details.

VOLUME DISCOUNTS CALL US AT **888-837-6437** FOR A PRICE QUOTATION

DIFFRACTION APPARATUS

$549 ORDER CODE **DAK**

The Diffraction Apparatus consists of a laser light source, a collection of diffraction and interference slits, and a novel Linear Position Sensor and High Sensitivity Light Sensor. Map light intensity versus position for many slit geometries. Mounts on a Vernier Track (not included).

ADVANCED PHYSICS – BEYOND MECHANICS ACCESSORIES

Extensive use is made of these accessories in our *Advanced Physics with Vernier – Beyond Mechanics* lab manual, and they are highly recommended. Refer to the list of experiments on the opposite page.

Power Amplifier Accessory Speaker	PAAS-PAMP	$99
Electrostatics Kit	ESK-CRG	$109
Resistivity Rod Set	RRS	$45
Vernier Circuit Board	VCB	$89
Inductor	IND	$40
Optics Expansion Kit	OEK	$169
Mirror Set	M-OEK	$59

$199 a

$99 b

$169 c

$110 d

$225 e

a. Power Amplifier, ORDER CODE **PAMP, $199**

The Vernier Power Amplifier allows you to drive loads with ±10 V and currents up to 1 A. Works with any waveform, including DC, sine, square, triangle, and sawtooth waveforms. The Power Amplifier can drive a variety of loads, including speakers, lamps, small DC motors, and RLC circuits. More on page 133.

b. Power Amplifier Accessory Speaker

ORDER CODE **PAAS-PAMP, $99**

This kit includes a speaker and accessories used with the Vernier Power Amplifier to study mechanical waves and springs. The speaker contains a lightweight metal disc glued to the speaker cone. A drive post attached to the metal plate allows you to drive elastic materials such as strings and springs.

c. Rotary Motion Sensor

ORDER CODE **RMV-BTD, $169**

Our Rotary Motion Sensor lets you monitor angular motion precisely and easily and is direction sensitive. Use it to collect angular displacement, angular velocity, and angular acceleration data.

d. Rotational Motion Accessory Kit

ORDER CODE **AK-RMV, $110**

This accessory kit is used to study the motion of a physical pendulum; the rotational inertia of disks, rings, and point masses; and the conservation of angular momentum.

e. Force Plate*, ORDER CODE **FP-BTA, $225**

The Force Plate is a large force sensor—tough enough to jump on. About the size and shape of a bathroom scale, the Force Plate has two ranges: one reading up to 3500 N, and the other to 800 N. Two handles are included for pushing or pulling. Additional pairs of handles are available (ORDER CODE FP-HAN, $15).

*Additional shipping charges may apply.

Experiment 32 from* Physics with Vernier, *"Sound Waves and Beats"

Exploring Newton's Third Law

Analyzing gas tube emission spectra

Spectrum Tube Carousel Power Supply

ORDER CODE **ST-CAR, $285**

The Spectrum Tube Carousel Power Supply features the same ultra-safe, patent-pending design of the Spectrum Tube Single Power Supply version but holds eight gas spectrum tubes simultaneously. You can quickly switch from one gas to another without handling the tubes. Includes a Spectrum Tube Fiber Optic Holder Carousel.

The Red Tide Emissions Spectrometer and Optical Fiber are used here with the Spectrum Tube Carousel Power Supply.

f. Red Tide Emissions Spectrometer

ORDER CODE **ESRT-VIS, $1,154**

The perfect tool to conduct emissions analysis and much more. It connects directly to your computer with a standard USB cable and gives precise measurements over a range of 380–950 nm. Use the Red Tide Emissions Spectrometer with a recommended Optical Fiber Assembly to add versatility and allow a greater range of analysis options. More on page 48.

See **www.vernier.com/esrt-vis** for details.

g. Optical Fiber, ORDER CODE VIS-NIR, $138

400 µm diameter VIS-NIR Optical Fiber. Fiber is used to pipe light from sources to a spectrometer.

h. Spectrum Tube Single Power Supply

ORDER CODE **ST-SPS, $225**

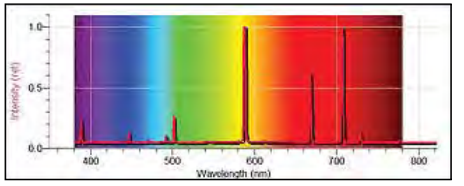
The Spectrum Tube Single Power Supply provides an ultra-safe means of generating gas discharges. View the spectral lines with any of our spectrometers. With no exposed high voltage, tubes are permanently enclosed in protective plastic carriers. There are no through-the-glass electrodes, so tubes are long lasting. One tube is energized at a time, and there are storage slots for six more tubes. Includes a Spectrum Tube Fiber Optic Holder. All tubes sold separately.

Spectrum Tube:

Hydrogen, ORDER CODE **ST-H, $36**
Nitrogen, ORDER CODE **ST-N, $36**
Helium, ORDER CODE **ST-HE, $36**
Neon, ORDER CODE **ST-NE, $36**
Carbon Dioxide, ORDER CODE **ST-CO2, $36**
Air, ORDER CODE **ST-AIR, $36**
Argon, ORDER CODE **ST-AR, $36**

Spectrum Tube Power Supplies carry a two-year warranty (one year on tubes).

f $1,154



g $138

VIS-NIR Optical Fiber

h $225

$89 a

$199 b

$17 c

a. Vernier Circuit Board, ORDER CODE VCB, $89

The Vernier Circuit Board is a simple board that makes it easy to create circuits without a lot of loose components. Includes a resettable fuse, two powering options, resistors, capacitors, an LED, lamps, and binding posts to add your own components.

---

b. Extech Digital DC Power Supply

ORDER CODE EXPS, $199

The Extech Digital DC Power Supply has three outputs: adjustable 0–30 V at 0–3 A, fixed 5 V, and fixed 12 V. It provides constant current or constant voltage modes and has overload and short circuit protection. Binding post terminals are provided for the variable supply. Easy snap terminals are provided for the 5 V and 12 V outputs. The front panel contains digital voltage and current meters for the variable output, so you won't need additional metering in a typical experiment. The Extech Digital DC Power Supply comes with a one-year warranty.

---

c. Photogate Bar Tape Kit

ORDER CODE TAPE-VPG, $17

The Photogate Bar Tape Kit contains a flexible plastic tape called "Bar Tape" and a guide that allows the tape to be used with a Vernier Photogate. The tape can be attached to objects and pulled through the photogate. This allows you to perform experiments as you would with a ticker tape timer.

Studying Ohm's law using the Current Probe, Differential Voltage Probe, and the Vernier Circuit Board

Radiation Monitors and Lab Book

NEW Vernier Radiation Monitor

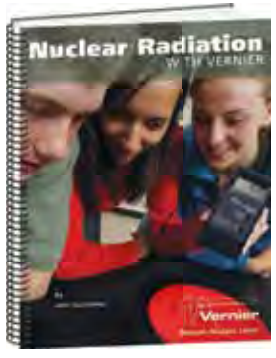
$169 ORDER CODE **VRM-BTD**

The Vernier Radiation Monitor detects alpha, beta, gamma, and X-ray radiation using a Geiger-Mueller tube. Use the monitor for experiments in nuclear counting statistics, shielding, and decay rate measurements. No battery is required, as the Monitor gets power from the interface, such as LabQuest.

Digital Radiation Monitor

$299 ORDER CODE **DRM-BTD**

The Digital Radiation Monitor consists of a Geiger-Mueller tube and a digital rate meter mounted in a small, rugged, plastic case with a digital meter. The unit is battery operated and can be used with or without a computer for measurement of alpha, beta, and gamma radiation. It can be used to explore radiation statistics and to measure the rate of nuclear decay.



Nuclear Radiation with Vernier lab book

by John Gastineau

$25 ORDER CODE **NRV**

This book contains six experiments for data collection using our Radiation Monitors: Distance and Radiation; Counting Statistics; Lifetime Measurement; Background Radiation Sources; Radiation Shielding; and Alpha, Beta, and Gamma.

e. Charge Sensor, ORDER CODE CRG-BTA, $75

The Charge Sensor is used as an electronic electroscope. An extremely high impedance voltage sensor with a 0.01 µF input capacitor makes possible quantitative measurements in many electrostatic experiments. The sensor has three operating ranges and a zeroing switch to discharge the input capacitor. For detailed specifications, see page 121.

f. Electrostatics Kit

ORDER CODE **ESK-CRG, $109**

The Electrostatics Kit is an accessory for the Vernier Charge Sensor. This kit allows students to perform a range of experiments in electrostatics including the use of Faraday's Pail, quantitative and qualitative measurement of charge, charging by friction, charging by contact, and charging by induction. The kit includes

- Faraday Pail and cage
- Grounding plane
- Grounding wires and wrist strap
- Charge producers and proof plane
- Wool, vinyl, nylon rod, PVC rod
- Cotton cloth

g. High-Voltage Electrostatics Kit

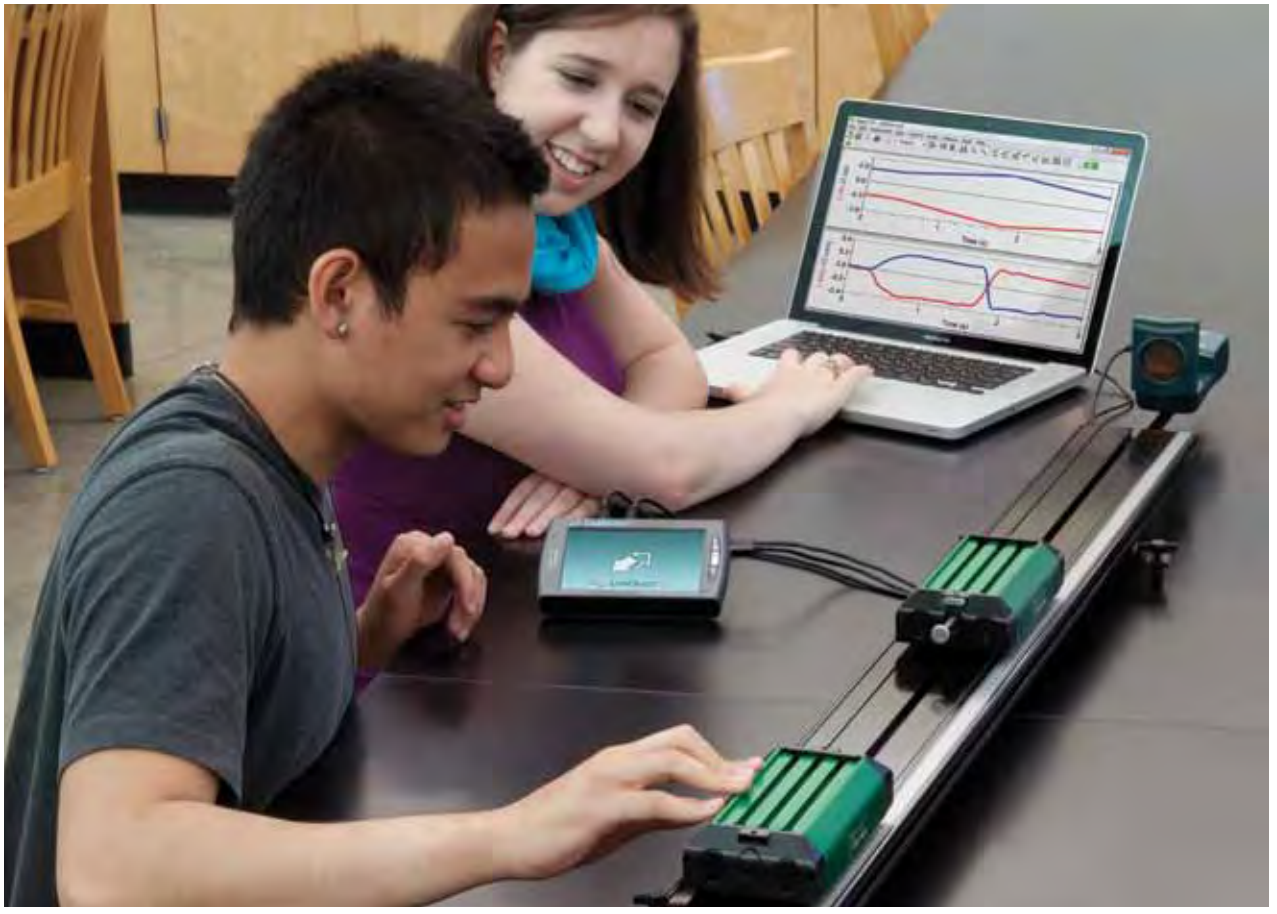
ORDER CODE **HVEK-CRG, $249**

The High-Voltage Electrostatics Kit is an accessory for the Vernier Charge Sensor. Use it with a Faraday Pail and the Charge Sensor to investigate the distribution of charge on a sphere, transfer of charge on contact between two spheres, and charging by induction. The kit includes an electrostatics voltage source (output 750, 1500, 3000, 6000 VDC) and two conducting spheres. Extremely low output current makes this device safe for classroom use.

e $75

f $109

g $249



Vernier Dynamics Carts

- Perfect for kinematics and dynamics experiments.
- Easily attach a Dual-Range Force Sensor or our Wireless Dynamics Sensor System.
- Use them with our Motion Detector.
- Roll the cart down a ramp to study constant acceleration.
- Use two carts to study momentum conservation.
- With extremely low friction due to sealed bearings and machined wheels, our superior carts give very high quality data.
- Interchangeable magnetic and hook-and-pile end caps make it possible to do many experiments.
- The Plunger Cart has a spring-loaded plunger for consistent collisions, while the Standard Cart is similar, but has no plunger.
- Vernier carts are compatible with other common carts and tracks.

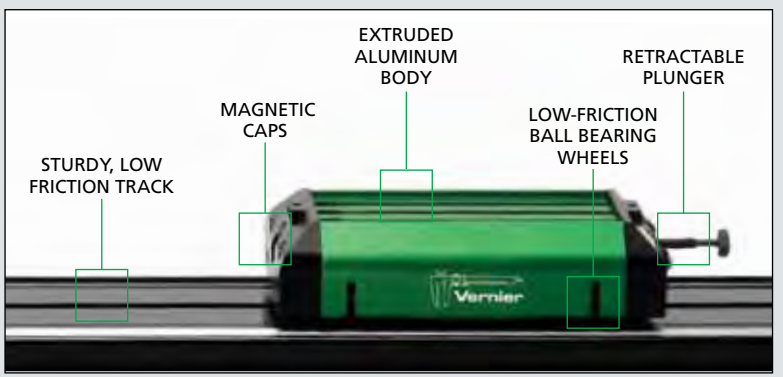
EXPERIMENTS FOR CART AND TRACK

- Measuring *g* on an Incline
- Newton's Second Law
- Momentum, Energy, and Collisions
- Impulse and Momentum

These experiments can be found in our lab book Physics with Vernier *(see page 78).*

Dynamics Cart with WDSS attached

Dual-Range Force Sensor and Accelerometer



2.2 m Track

For Wireless Dynamic Sensor System, see page 95.

$229 ORDER CODE **TRACK-LONG**

BUMPER AND LAUNCHER KIT

$89 ORDER CODE **BLK**

Contains accessories for experiments involving the Vernier Dual-Range Force Sensor, Vernier Wireless Dynamics Sensor System, and the Vernier Dynamics System. The accessories allow you to perform a wide range of experiments in kinematics and dynamics.

Vernier Bumper and Launcher Kit Includes:

- One track bracket
- One dual-magnet bumper
- One DFS end mount screw
- Two magnetic bumpers
- Two rubber bumpers
- Two hoop bumpers
- Two clay holders
- One small brick of clay

Vernier Dynamics System

Use the Vernier Dynamics System to improve your kinematics and dynamics experiments. The Dynamics System is ideal for studying Newton's second law, acceleration on an inclined plane, momentum, and much more. Vernier sensors such as our Motion Detector, Dual-Range Force Sensor, Wireless Dynamics Sensor System, Photogate, and Accelerometer easily attach to the Dynamics System. Make the most of your track by adding the Vernier Optics Expansion Kit for studying optics. See pp. 90–91.

$279* ORDER CODE **VDS**

Vernier Dynamics System Includes:

ONLY $279

- Combination 1.2 m Dynamics Track/Optics Bench
- Standard Cart with magnetic and hook-and-pile end caps
- Plunger Cart with magnetic and hook-and-pile end caps
- Mass – 500 g
- Adjustable End Stop
- Two Adjustable Two Foot Levelers
- Motion Detector Bracket
- Two Photogate Brackets
- Rod Clamp

VERNIER DYNAMICS SYSTEM WITH LONG TRACK

$399 ORDER CODE **VDS-LONG**

The long-track version includes the same carts and accessories as the standard system but substitutes a 2.2 m track for the 1.2 m track.

* Additional shipping charges may apply.

Cart Fan

$60 ORDER CODE **FAN-VDS**

Friction Pad

$30 ORDER CODE **PAD-VDS**

Pulley Bracket

$12 ORDER CODE **B-SPA**

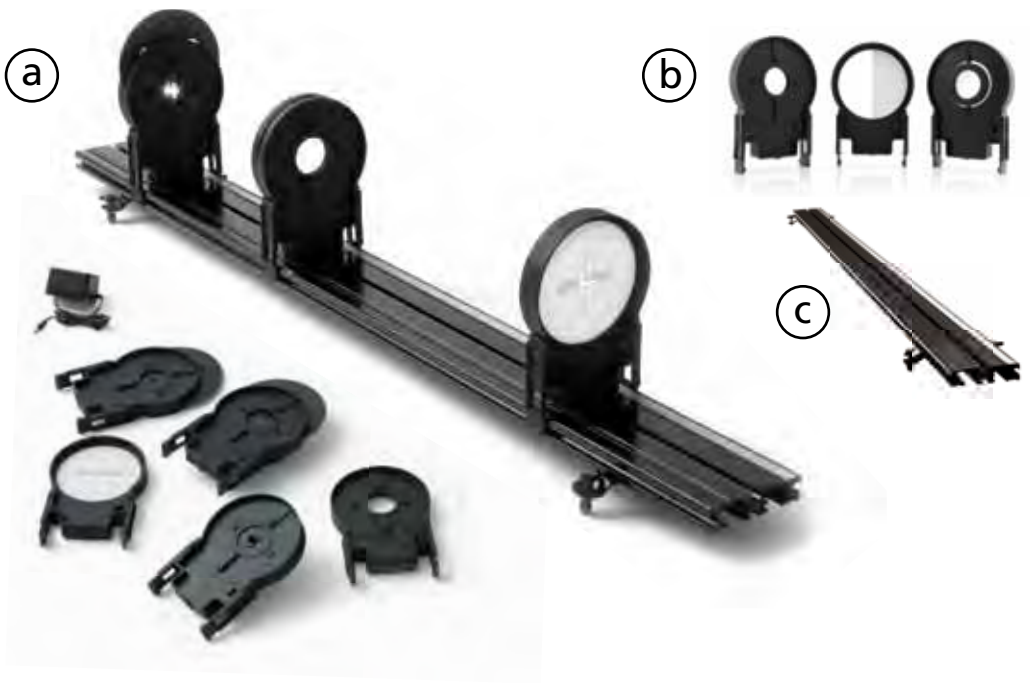
Ultra Pulley Attachment

$24 ORDER CODE **SPA**

MORE DYNAMICS SYSTEM ACCESSORIES

Additional 1.2 m Track, ORDER CODE **TRACK, $119**
2.2 m Track, ORDER CODE **TRACK-LONG, $229**
Standard Cart, ORDER CODE **CART-S, $85**
Plunger Cart, ORDER CODE **CART-P, $98**
Cart Picket Fence, ORDER CODE **PF-CART, $6**

Viewing an inverted image using a single thin lens from the Optics Expansion Kit mounted on the Vernier Dynamics System track



Vernier Optics System

Expand the use of your Vernier Dynamics System by adding these optics products.

$169 ORDER CODE OEK

a. Optics Expansion Kit, ORDER CODE OEK, $169

Add the Vernier Optics Expansion Kit to your dynamics track to conduct optics experiments, such as image formation with lenses and light intensity *vs.* distance. You can even use the kit to build a basic telescope.

Vernier Optics Expansion Kit Includes:

- Three lens holders with bases
- 100 mm converging lens
- 200 mm converging lens
- -150 mm diverging lens
- Screen, holder, and base
- Combination luminous and point light source
- Light sensor holder
- Aperture screen
- Power Supply

The Optics Expansion Kit extends the capabilities of the Vernier Dynamics System track (sold separately).

Download free sample experiments online: **www.vernier.com/oek**

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b. Mirror Set, ORDER CODE M-OEK, $59

The Mirror Set for the Optics Expansion Kit extends the kit to allow students to easily study image formation by concave and convex mirrors. Includes a concave mirror, a convex mirror, and a half screen for viewing images formed by the mirrors. Requires components from the Optics Expansion Kit for use.

---

c. Combination 1.2 m Track/Optics Bench, ORDER CODE TRACK, $119

The Combination Dynamics Track and Optical Bench is black anodized aluminum and includes a metric scale. Extremely rigid, this 1.2 meter track will not sag under use. The track includes two adjustable foot levelers.

a. Color Mixer, ORDER CODE CM-OEK, $150

The Color Mixer accessory for the Vernier Dynamics System consists of a three-color LED source, a lens, and a screen. These all attach to a Vernier Track and can be used to study the mixing of red, blue, and green light by additive and subtractive mixing. These simple experiments show how modern computer and television displays work.

The intensity of each LED can be controlled easily, demonstrating color addition. For subtraction, you can create shadows by placing objects in the light path.

The Color Mixer Kit extends the capabilities of the Vernier Dynamics System track (sold separately).

MORE ONLINE – Download a free sample experiment:
www.vernier.com/cm-oek

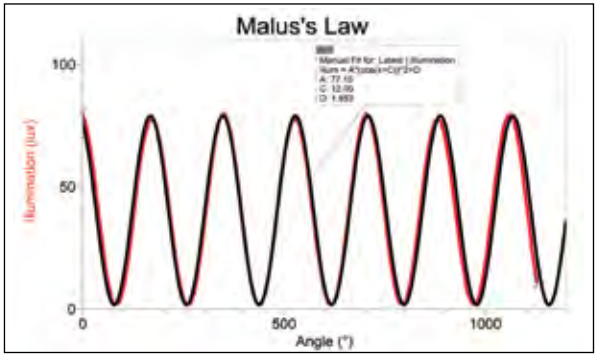
---

b. Polarizer/Analyzer Set, ORDER CODE PAK-OEK, $74

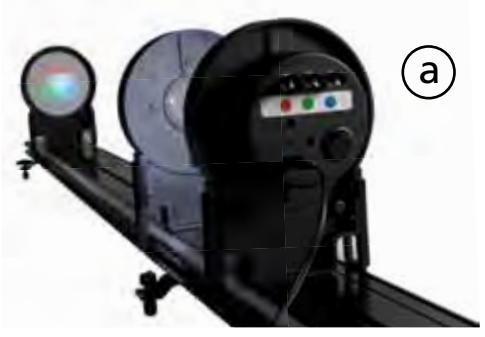
The Polarizer/Analyzer Set allows students to study light polarization, doing experiments such as Malus's Law. The set consists of three adjustable linear polarizers, one of which includes attachment points for the Vernier Rotary Motion Sensor.

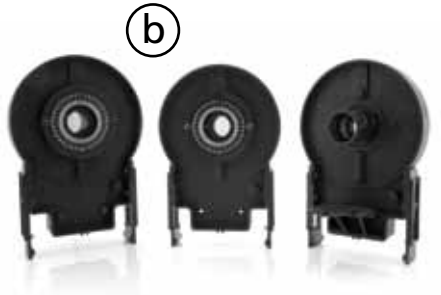
A complete experiment requires the Vernier Dynamics System Track, a Vernier Light Sensor, and the Light Sensor Holder and Light Source from the Optics Expansion Kit (all sold separately). Optionally, a Vernier Rotary Motion Sensor allows sensor-based angle measurement.

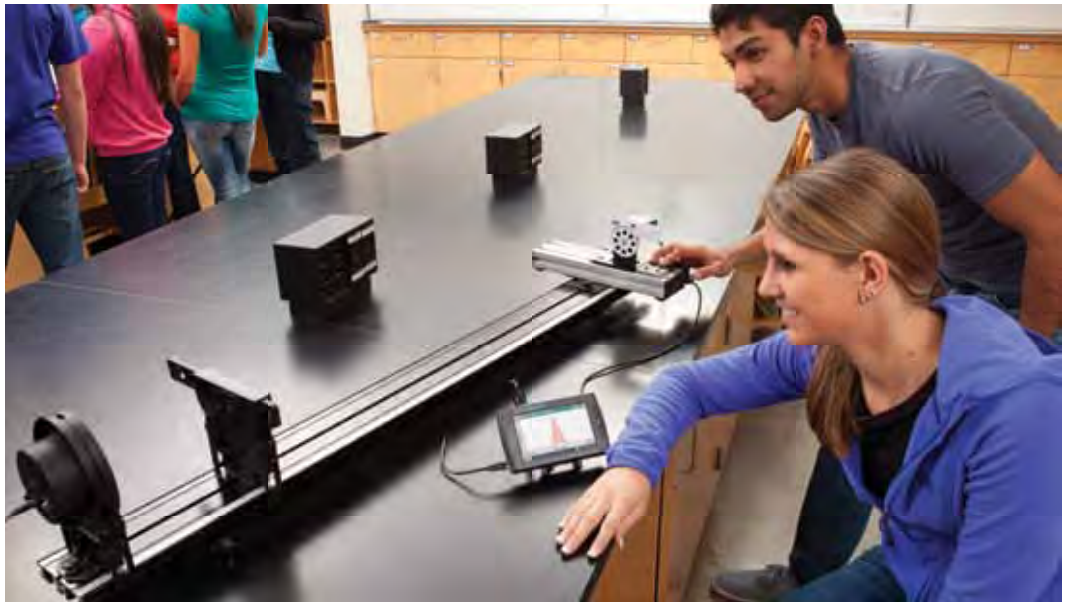
Mixing equal intensities of red, blue, and green to get white light



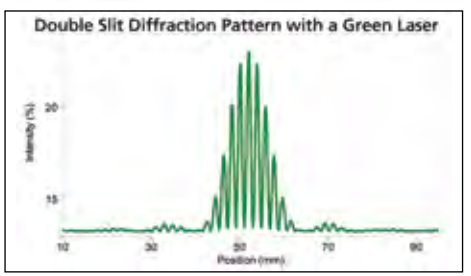
These data show a basic Malus's law experiment done with the Polarizer/Analyzer Set.







Collecting intensity vs. position data for a diffraction pattern



Double-slit diffraction pattern with 0.04 mm slits separated by 0.25 mm, 532 nm laser wavelength

Diffraction Apparatus

$549 ORDER CODE DAK

a. Diffraction Apparatus, ORDER CODE DAK, $549

The Diffraction Apparatus lets students create, view, and measure diffraction and interference patterns. The included Red Diffraction Laser provides a clean monochromatic light source. Slits are made by depositing metal film on glass, creating extraordinarily clean slits with fully opaque blocking areas. These high-precision slits cast clean diffraction and interference patterns, ideal for quantitative matching of intensity *vs.* position predictions.

The Linear Position Sensor and High Sensitivity Light Sensor completes the Diffraction Apparatus. In order to provide excellent spatial resolution, a selectable entrance aperture restricts the width of the pattern viewed by the High Sensitivity Light Sensor. The light sensor has three ranges, allowing the study of fine details or gross features of patterns. To measure position, the light sensor is mounted on a novel Linear Position Sensor.

This position sensor uses a precision optical encoder to measure translation with better than a 50 micron resolution. Since it is optically based, without gears or racks, it has zero backlash.

Data collection is performed by choosing a slit, directing the laser through the slit, and choosing an entrance aperture for the light sensor. Both the light sensor and position sensor connect to your interface. The light sensor is moved by hand over a 150 mm distance, tracing out the diffraction pattern.

The Diffraction Apparatus requires a Combination 1.2 m Track/Optics Bench, individually or part of the Vernier Dynamics System. An optional Green Diffraction Laser is also available, so that the effect of wavelength on the pattern can be measured.

---

b. Green Diffraction Laser, ORDER CODE GDL-DAK, $250

The Green Diffraction Laser is an optional accessory for the Diffraction Apparatus. Operating at 532 nm, it allows students to see and measure how diffraction patterns depend on light wavelength.

Note that the Green Laser does not include its own power supply. It uses the same power supply as the Red Diffraction Laser, which is the same as the LabQuest power supply.

Projectile Launcher

$299 ORDER CODE **VPL**

a. Projectile Launcher, ORDER CODE VPL, $299

Use the Vernier Projectile Launcher to investigate important concepts in two-dimensional kinematics. Launch steel balls at angles between 0 and 70 degrees and up to a distance of 2.5 m. A unique pneumatic launching system provides excellent repeatability and allows you to adjust the launch speed. Built-in photogates and angle markings provide easy and accurate measurement of the ball's launch velocity, allowing for precise quantitative analysis of projectile motion.

Includes: launcher, six steel balls, hand pump, two pairs of goggles, level, roll of waxed marking paper, photogate cable

Product Specifications
Launch angle: 0 to 70 degrees
Launch speed: 0-6 m/s
Launch height: 146 mm
Internal photogate interval: 50 mm
Steel ball mass: 21.8 g
Steel ball diameter: 17.5 mm

b. NEW Projectile Stop, ORDER CODE PS-VPL, $40

The Projectile Stop has one job: to keep the projectiles from the Vernier Projectile Launcher from rolling out of sight. Place the Projectile Stop in the launch line, beyond the landing site, and the projectile will be caught.

c. NEW Time of Flight Pad, ORDER CODE TOF-VPL, $77

The Time of Flight Pad is used to precisely measure how long a projectile has been in motion. Use it with the Vernier Projectile Launcher and a Vernier interface to determine the launch speed of a projectile, along with the time the projectile is in flight.

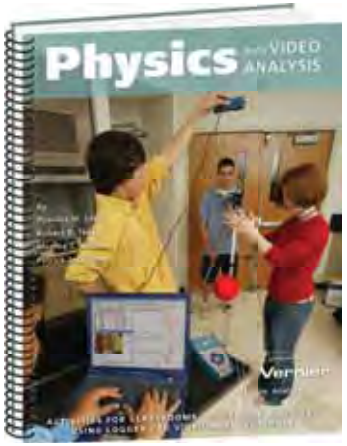
d. NEW Independence of Motion Accessory

ORDER CODE IOM-VPL, $49

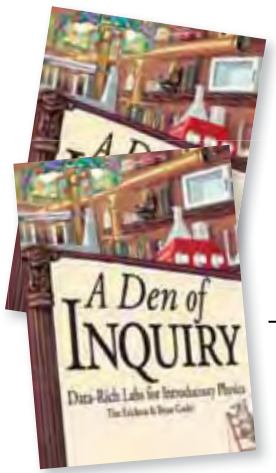
The Independence of Motion Accessory enables the Vernier Projectile Launcher to perform the classic experiment where one ball is dropped as another is projected horizontally. The balls strike the floor simultaneously.

MORE ONLINE – For more information on the Projectile Launcher, visit **www.vernier.com/vpl**

Measuring the time of flight of a projectile



$48 (a)



$40 (b)

$40 (c)

a. *Physics with Video Analysis*
ORDER CODE **PVA, $48**

by Priscilla Laws, Robert Teese, Maxine Willis, and Patrick Cooney

Physics with Video Analysis contains a wide selection of video analysis activities for introductory physics at either the high school or college level. Topics include kinematics, dynamics, circuits, sound, electrostatics, and more. Includes a CD with professionally made videos, student activities, solutions, and Logger *Pro* setup files.

MORE ONLINE – Free sample activities and videos are available on our web site at **www.vernier.com/livephoto**

A Den of Inquiry *by Tim Erikson*

b. Volume 1, ORDER CODE **DEN, $40**

Fifteen labs for introductory physics. These labs emphasize data analysis and mathematical modeling, but they do not require sensors. The book includes files and instructions for Logger *Pro* and for Fathom. Each lab includes teacher notes and black line masters.

c. Volume 2, ORDER CODE **DEN2, $40**

Sixteen sensor-based activities for introductory physics. Topics include kinematics, mechanics and energy; activities emphasize data analysis and modeling. Either Fathom 2.1 or Logger *Pro* software can be used.

Additional physics curriculum
For details on the following, go to **www.vernier.com/books** and click on Physics.

- Tools for Scientific Thinking
- RealTime Physics Activity Guides
- Workshop Physics
- Understanding Physics
- Interactive Lecture Demonstrations

VERNIER VIDEO PHYSICS

Vernier Video Physics brings video analysis to iPad, iPhone, and iPod touch. Track an object, set the scale, and see graphs of trajectory, position, and velocity. See page 22 for more information.

Available on the App Store

//CODiE// 2012 SIIA CODIE FINALIST

AMUSEMENT PARK PHYSICS *by Clarence Bakken*

ORDER CODE **AMPK, $35**

The book, *Amusement Park Physics*, is an excellent resource for teachers who want their students to connect their experiences at an amusement park to the physics concepts studied in class. The book explains how the instruments used to collect data, including electronic sensors, work on a conceptual level. A key portion of the book discusses taking your class to the amusement park and includes sample lab sheets and problem sets.

DATA VEST, ORDER CODE DV, $34

The Data Vest makes hands-free data collection at an amusement park or playground easy. The vest has a front pouch for the LabQuest, LabPro, CBL 2, or the Wireless Dynamics Sensor System. It has two inside pockets for the sensors and side straps to hold the vest in place.

ACTIVITY BASED PHYSICS HIGH SCHOOL E-DITION

ORDER CODE **ABP-E, $250, Download Only**

The *Activity Based Physics* High School e-dition is a special pre-college edition of physics curriculum from the Wiley Physics Suite, including *RealTime Physics*, *Workshop Physics*, and *Interactive Lecture Demonstrations*. See **www.vernier.com/abp-e**

A COMPLETELY WIRELESS SENSOR SYSTEM

The Wireless Dynamics Sensor System combines a 3-axis accelerometer, force sensor, and altimeter into one unit that communicates wirelessly with your computer via Bluetooth®. You can also use it as a standalone data logger. It's more than just a wireless sensor; it's a complete data-collection system completely free of friction due to cables.

Wireless Dynamics Sensor System

ORDER CODE **WDSS, $249**

Includes a rechargeable battery* and charger, bumpers for collisions, hooks for mounting the unit in different positions, mounting hardware for Vernier and other dynamics carts, and a manual.

YOU ALSO NEED:

Computer use

- Logger *Pro* 3 software
- Either compatible built-in Bluetooth or Bluetooth USB Dongle

LabQuest use

- LabQuest 2
  or
- Original LabQuest with Bluetooth USB Dongle

Bluetooth USB Dongle Radio

ORDER CODE **BLUE-USB, $35**

Each computer used with a WDSS must have a Bluetooth radio. This convenient USB dongle adds Bluetooth capabilities to any original LabQuest, Windows XP SP2, Vista, Windows 7, or Mac OS X 10.4 or newer computer that lacks Bluetooth. It can also be used with a LabQuest to add Bluetooth capabilities to LabQuest. (requires LabQuest App 1.5, or newer)

* The Wireless Dynamics Sensor System battery carries a one-year warranty.

Wireless Dynamics Sensor System

Altimeter
Record changes in altitude for roller-coaster physics.

3-Axis Accelerometer
Three orthogonally mounted sensors let you measure acceleration in all directions.

Data-Collection Status

Communication Status

On-Board Memory
Retains data even after the unit is turned off.

Multiple Mounting Options
Mount the device in almost any orientation using standard hardware.

Battery Charging Indicator

Start/Stop Collection Button
Simple, one-button operation allows you to start and stop data collection when away from the computer.

Force Sensor
Custom load cell provides accurate, repeatable results.

Additional Hook
Allows the device to be mounted in-line for tension and pendulum experiments.

$249 ORDER CODE WDSS

- Measures acceleration, force, and altitude
- Wireless real-time data collection
- Works as a standalone data logger

WIRELESS DYNAMICS SENSOR SYSTEM
FORCE • ACCELERATION • ALTITUDE

SPECIFICATIONS

INTERNAL DATA STORAGE CAPACITY: 240,000 points
MAXIMUM SAMPLING RATE: 1000 samples/second

FORCE

RANGE: ±50 N
RESOLUTION: 0.006 N (<10 N)
0.03 N (>10 N)

ACCELEROMETERS *(FOR EACH AXIS)*

RANGE: ±50 m/s² (±5 g)
RESOLUTION: 0.04 m/s²

ALTIMETER

ALTITUDE CHANGE RANGE: +/-200 m
RESOLUTION: 1 m

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with Vernier lab books. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators, unless otherwise noted.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 14–15.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own.

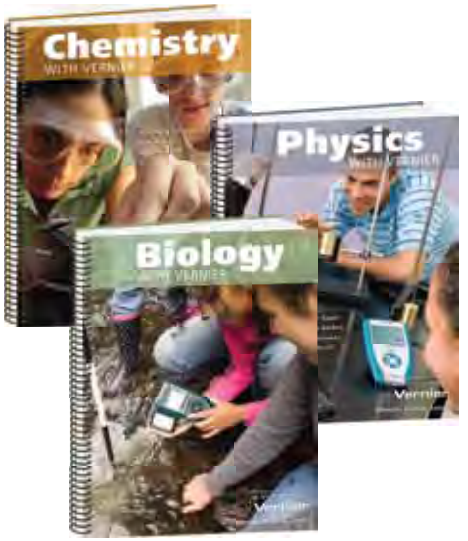
Our Science Department Deluxe Package includes the most frequently used sensors for a variety of science courses to support your entire department.

For a complete list of sensors by subject:

Biology pp. 25, 27
Chemistry pp. 39, 41, 43
Earth Science page 53
Environmental Science page 65
Math page 73
Middle School Science page 69
Physical Science page 75
Physics pp. 79, 81, 83
Water Quality page 99

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 18–21 for details.



SCIENCE LAB BOOKS

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- Ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD, unless otherwise noted.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/labs**

See pp. 100–107 for more information on all of our lab books.

VERNIER LAB BOOKS THAT USE PROBES INCLUDED IN OUR SCIENCE DEPARTMENT PACKAGES

	Stainless Steel Temperature Probe	Light Sensor	Voltage Probe	Motion Detector	Dual-Range Force Sensor	Microphone	Low-g Accelerometer	Magnetic Field Sensor	Gas Pressure Sensor	pH Sensor	Conductivity Probe	Colorimeter	Dissolved Oxygen Probe	CO_2 Gas Sensor	Hand-Grip Heart Rate Monitor
Biology	✔								✔	✔	✔	✔	✔	✔	✔
Chemistry	✔		✔						✔	✔	✔	✔			
Earth Science	✔	✔	✔	✔				✔		✔	✔				
Environmental	✔	✔	✔							✔	✔		✔	✔	
Math	✔	✔	✔	✔	✔	✔			✔	✔					
Middle School	✔	✔	✔	✔	✔			✔	✔	✔	✔				✔
Physical Science	✔	✔	✔	✔	✔			✔	✔	✔	✔				
Physics	✔	✔	✔	✔	✔	✔	✔	✔							
Water Quality	✔									✔	✔	✔	✔		

For more information visit **www.vernier.com/probes**

WHY USE PROBEWARE IN SCIENCE?

Hands-on science using Vernier technology gets students excited about science and deepens their understanding of complex concepts. It gives students the tools to analyze data and think like real scientists. Request our **White Paper** at **www.vernier.com/whitepaper**

Science Department LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Deluxe Package LQ2-SCI-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329
Stainless Steel Temperature Probe	TMP-BTA	$29
Light Sensor	LS-BTA	$55
Voltage Probe	VP-BTA	$12
Motion Detector	MD-BTD	$79
Dual-Range Force Sensor	DFS-BTA	$109
Microphone	MCA-BTA	$39
Low-g Accelerometer	LGA-BTA	$89
Magnetic Field Sensor	MG-BTA	$58
pH Sensor	PH-BTA	$79
Gas Pressure Sensor	GPS-BTA	$83
Conductivity Probe	CON-BTA	$95
Dissolved Oxygen Probe	DO-BTA	$209
Colorimeter	COL-BTA	$115
CO_2 Gas Sensor	CO2-BTA	$249
Hand-Grip Heart Rate Monitor	HGH-BTA	$119
PACKAGE PRICE		**$1,748**

DELUXE

YOU WILL ALSO NEED:

Lab books, see pp. 100–107.

Logger *Pro* 3 software, ORDER CODE **LP, $229**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,696 EACH AND **SAVE $416!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Deluxe Package LM-SCI-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149
Stainless Steel Temperature Probe	TMP-BTA	$29
Light Sensor	LS-BTA	$55
Voltage Probe	VP-BTA	$12
Motion Detector	MD-BTD	$79
Dual-Range Force Sensor	DFS-BTA	$109
Microphone	MCA-BTA	$39
Low-g Accelerometer	LGA-BTA	$89
Magnetic Field Sensor	MG-BTA	$58
Gas Pressure Sensor	GPS-BTA	$83
pH Sensor	PH-BTA	$79
Conductivity Probe	CON-BTA	$95
Colorimeter	COL-BTA	$115
Dissolved Oxygen Probe	DO-BTA	$209
CO_2 Gas Sensor	CO2-BTA	$249
Hand-Grip Heart Rate Monitor	HGH-BTA	$119
PACKAGE PRICE		**$1,568**

DELUXE

YOU WILL ALSO NEED:

Lab books, see pp. 100–107.

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FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 110–117

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Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

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This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 18–21 for details.

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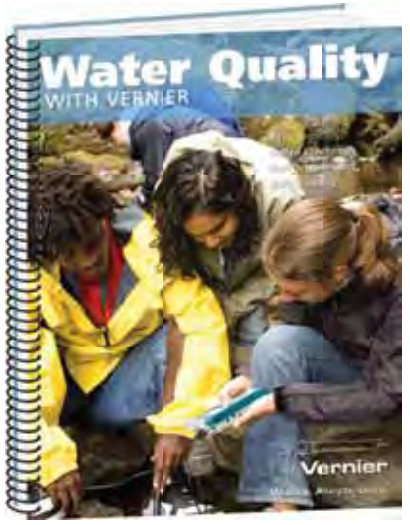

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- Essential teacher information.
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- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/wqv**

Water Quality with Vernier lab book contains the following water quality tests:

☐ **USING A DISSOLVED OXYGEN SENSOR**
- Dissolved Oxygen
- Biochemical Oxygen Demand

☐ **USING A TEMPERATURE PROBE**
- Temperature

☐ **USING A pH SENSOR**
- pH
- Alkalinity

☐ **USING A TURBIDITY SENSOR**
- Turbidity

☐ **USING A CONDUCTIVITY PROBE**
- Total Dissolved Solids
- Chloride and Salinity

☐ **USING A COLORIMETER**
- Phosphates, Ortho- and Total
- Nitrate

☐ **USING A FLOW RATE SENSOR**
- Flow Rate and Stream Discharge

☐ **USING ION-SELECTIVE ELECTRODES****
- Nitrate
- Ammonium Nitrogen
- Calcium and Water Hardness
- Chloride and Salinity

WATER TESTS REQUIRING NO SENSOR
- Total Solids
- Fecal Coliform
- Total Water Hardness

WATER-QUALITY INDEX TESTS
- Temperature
- pH
- Turbidity
- Total Solids
- Dissolved Oxygen
- Biochemical Oxygen Demand
- Phosphates, Ortho- and Total
- Fecal Coliform
- Nitrate

☐ STARTER PACKAGES ☐ DELUXE PACKAGES

** Ion-Selective Electrodes require good chemical technique and careful calibration to obtain accurate results. They are not recommended for middle school or elementary students.

AP Many of the experiments in our water quality lab book are the perfect complement to labs for AP* Environmental Science. See **www.vernier.com/ap**

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Use Vernier sensors to collect GLOBE data! The following Vernier sensors meet GLOBE specifications:

- Dissolved Oxygen Probe
- pH Sensor
- Stainless Steel Temperature Probe
- Conductivity Probe
- Barometer
- Relative Humidity Sensor
- Turbidity Sensor
- Salinity Sensor
- Nitrate Ion-Selective Electrode
- Soil Moisture Sensor

To learn more about Vernier and GLOBE, see **www.vernier.com/globe**

Water Quality LabQuest 2 Packages

Purchase one package per lab group (2–4 students) or BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone or Computer

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-WQ-STR	Deluxe Package LQ2-WQ-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
pH Sensor	PH-BTA	$79	$79
Dissolved Oxygen Probe*	DO-BTA	$209	$209
Conductivity Probe	CON-BTA	$95	$95
Turbidity Sensor	TRB-BTA	$112	$112
Colorimeter	COL-BTA		$115
Flow Rate Sensor	FLO-BTA		$129
Nitrate Ion-Selective Electrode	NO3-BTA		$179
Calcium Ion-Selective Electrode	CA-BTA		$179
Chloride Ion-Selective Electrode	CL-BTA		$179
Ammonium Ion-Selective Electrode	NH4-BTA		$179
PACKAGE PRICE		**$853**	**$1,813**

YOU WILL ALSO NEED:

- ***Water Quality with Vernier*** **lab book,** ORDER CODE **WQV, $48**
  See previous page.
- **Logger *Pro* 3 software,** ORDER CODE **LP, $229**
  Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 18–21 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,759 EACH AND **SAVE $432!**

*Packages containing the new Vernier Optical DO Probe will be available Spring 2013.

MORE PRODUCTS FOR WATER QUALITY TESTING

Salinity Sensor, ORDER CODE **SAL-BTA, $92**

Easily and precisely measures the total dissolved salt content in ocean or brackish water.

Extra-Long Temperature Probe
ORDER CODE **TPL-BTA, $79**

This probe has a 30-meter (100 ft) cable. It measures temperature at various depths in lakes and streams.

Water Depth Sampler, ORDER CODE **WDS, $71**

Use this device to collect water samples from any desired lake depth. A 50-foot nylon drop cord is included.

NEW Vernier Optical DO Probe Available Spring 2013
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Students can now measure the concentration of dissolved oxygen in water quickly and easily with the new Vernier Optical DO Probe. This probe can be used to measure dissolved oxygen concentration in surface water or to perform a wide variety of experiments to determine changes in dissolved oxygen levels, one of the primary indicators of the quality of an aquatic environment.

- Plug-and-play technology—no filling solution, warm-up time, calibration, or stirring necessary
- Built-in temperature and pressure compensation
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More details on page 35.

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Buy just one copy per classroom, photocopy the labs, or print them from the included CD.

Each book includes a CD with word-processing files of the student instructions for data collection using Logger *Pro* (computer), LabQuest App (LabQuest as a standalone device), and EasyData and DataMate (TI graphing calculators), unless otherwise noted.

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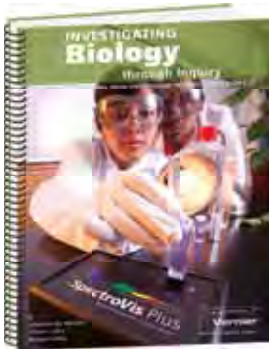

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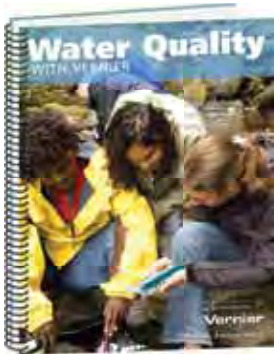

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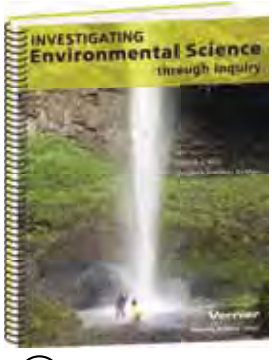

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a. *Biology with Vernier,* ORDER CODE **BWV, $48**
Highly recommended for first-year biology. This book contains 31 experiments in cell respiration, photosynthesis, membrane diffusion, osmosis, human physiology, transpiration, fermentation, and other important biology concepts. See page 24.

b. *Advanced Biology with Vernier,* ORDER CODE **BIO-A, $48**
Highly recommended for second-year or college biology. This book contains 17 experiments including the 12 traditional AP* Biology labs. Additional advanced-level experiments make it appropriate for introductory college biology courses, as well. See page 28.

c. *Investigating Biology through Inquiry,* ORDER CODE **BIO-I, $48**
Highly recommended for AP and IB† Biology.* This book, for data collection on computers and LabQuest only, will help you integrate inquiry into your high school or college biology curriculum. It provides many researchable questions for your students to investigate along with sample data for each investigation. See page 26.

d. *Human Physiology with Vernier,* ORDER CODE **HP-A, $48**
This book, for data collection on computers and LabQuest only, contains 24 human physiology experiments. The experiments are designed to encourage students to think about the physiology of various human organ systems. See page 32.

e. *Water Quality with Vernier,* ORDER CODE **WQV, $48**
This book contains 16 water quality tests, including pH, total dissolved solids, dissolved oxygen, BOD, flow rate, turbidity, nitrates, and phosphates. All nine tests in the Water Quality Index (WQI) are supported. See page 98.

f. *Investigating Environmental Science through Inquiry,* ORDER CODE **ESI, $48**
Highly recommended for those teaching inquiry-based environmental science. This book contains 34 inquiry-based investigations. It covers issues that prompt students' interest in the effects of man-made environmental changes. Includes correlations for AP* and IB† environmental science. Student instructions are not platform specific. See page 64.

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†The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

Did you know? You can customize the lab instructions on your LabQuest using My LabQuest Library. See page 106 for details.

a. *Chemistry with Vernier,* ORDER CODE **CWV, $48**
Highly recommended for first-year chemistry. This book contains 36 experiments in thermochemistry, gas laws, acid-base reactions, equilibrium, electrochemistry, electrolytes, states of matter, and more. See page 38.

b. *Advanced Chemistry with Vernier,* ORDER CODE **CHEM-A, $48**
Highly recommended for second-year, AP, or college chemistry. This book contains 35 advanced chemistry experiments. Many of the experiments align well with the 16 recommended AP chemistry experiments. See page 42.

c. *Investigating Chemistry through Inquiry,* ORDER CODE **CHEM-I, $48**
Highly recommended for AP Chemistry. This book contains 25 inquiry-based chemistry investigations in thermochemistry, acids and bases, stoichiometry, chemical kinetics, and properties of solutions. See page 40.

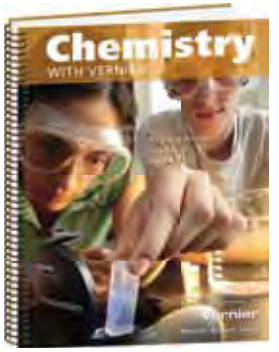
d. *Organic Chemistry with Vernier,* ORDER CODE **CHEM-O, $48**
This book contains experiments designed for college organic chemistry courses. Experiments cover a broad range of topics, including compound identification, synthesis, chromatography, optical rotation, and spectroscopy. Experiments are written for computer and LabQuest only. See page 44.

e. *Physics with Vernier,* ORDER CODE **PWV, $48**
Highly recommended for first-year physics. This book contains 35 experiments in mechanics, sound, light, electricity, and magnetism. See page 78.

f. *Advanced Physics with Vernier – Mechanics,* ORDER CODE **PHYS-AM, $48**
Highly recommended for AP Physics. This is the first of a two-volume set of experiments for the more in-depth introductory physics course, such as college physics, AP* Physics, or IB† Physics. Experiments are designed for an interactive teaching style and are written for computer and LabQuest only. See page 80.

g. *Advanced Physics with Vernier – Beyond Mechanics*
ORDER CODE **PHYS-ABM, $48**
Highly recommended for advanced physics courses. This is the second of a two-volume set of new experiments for the more in-depth introductory physics course, such as college physics, AP* Physics, or IB† Physics. Experiments are designed for an interactive teaching style and are written for computer and LabQuest only.
See page 82.

h. *Physics with Video Analysis,* ORDER CODE **PVA, $48**
This book contains a wide selection of video analysis activities using Logger *Pro* for introductory physics. Topics include kinematics, dynamics, circuits, sound, electrostatics, and more. Includes a CD with professionally made videos, student activities, solutions, and Logger *Pro* setup files. See page 94.



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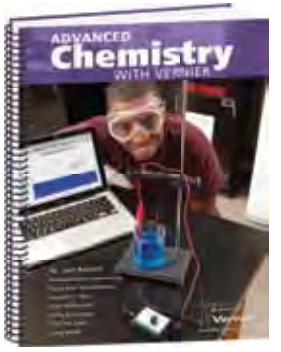

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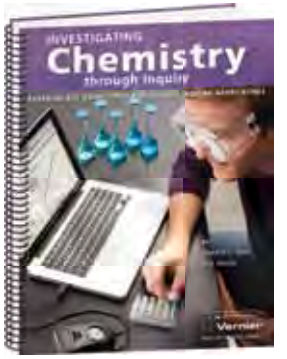

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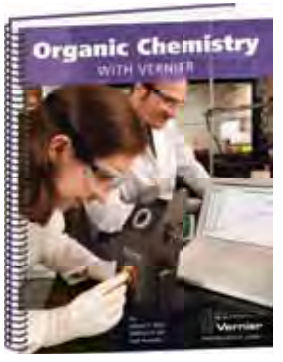

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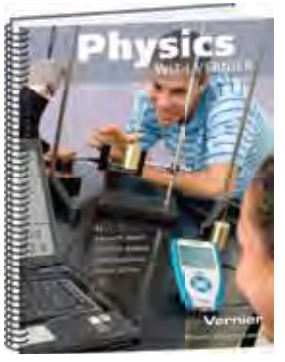

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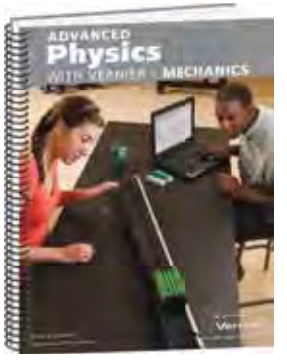

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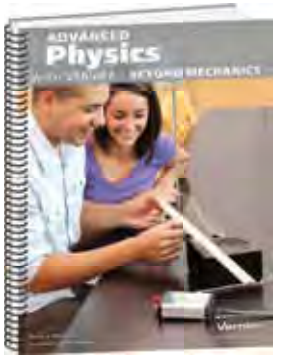

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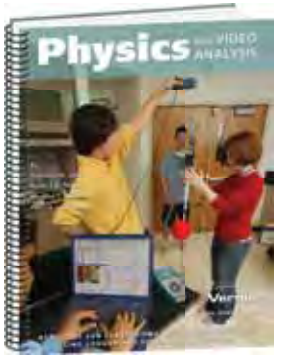

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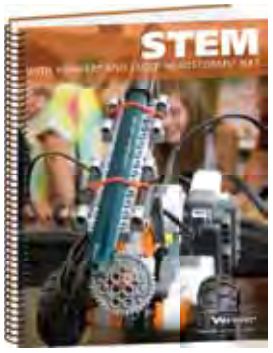

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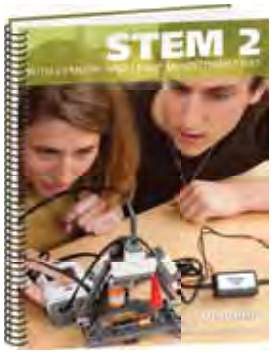

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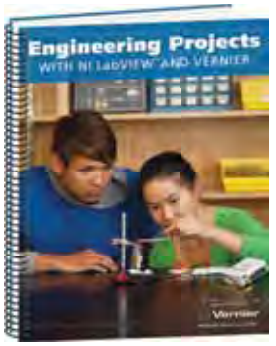

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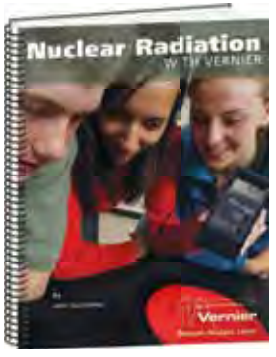

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a. *STEM with Vernier and LEGO® MINDSTORMS® NXT,* ORDER CODE **STEM, $35**
This book includes 14 environmental lab activities and 4 design-and-build robotics projects using pH, Conductivity, UV, and Soil Moisture Sensors coupled with the LEGO MINDSTORMS NXT intelligent interface. Includes a CD with MINDSTORMS NXT sample programs, movie clips, and LEGO Digital Designer files. See page 57.

b. *STEM 2 with Vernier and LEGO® MINDSTORMS® NXT*
ORDER CODE **STEM2, $35**
This is our second book of projects and activities for engineering eduction and includes 12 lab activities and 8 design-and-build robotics projects. It covers topics in physical science and engineering, including mechanics, pressure, electricity, and magnetism. Includes a CD with MINDSTORMS NXT sample programs, movie clips, and LEGO Digital Designer files. See page 56.

c. *Engineering Projects with NI LabVIEW™ and Vernier,* ORDER CODE **EPV, $48**
This book includes 12 engaging, hands-on projects that introduce engineering concepts and programming with NI LabVIEW software. Topics include analog and digital input and output, feedback and control, servo and stepper motors, PID control, and pulse-width modulation. See page 62.

d. *Hands-On Introduction to NI LabView™ with Vernier*
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e. *Real-World Math with Vernier,* ORDER CODE **RWV, $48**
This new lab book contains 32 activities that explore real-world applications of math concepts from algebra through calculus. Activities cover topics such as linear, quadratic, and periodic functions, statistics, systems of equations, and many more. This book is for data collection on computers and calculators only. See page 72.

f. *Science with TI-Nspire Technology,* ORDER CODE **SWN, $48**
We have taken 33 of our most popular laboratory activities and modified them for use with TI-Nspire handhelds and computer software. This book includes experiments for Earth/environmental science, biology, chemistry, and physics. This book is for data collection on TI-Nspire technology only. See page 112.

g. *Nuclear Radiation with Vernier,* ORDER CODE **NRV, $25**
This book contains six experiments for data collection with a radiation monitor including Distance and Radiation, Counting Statistics, Lifetime Measurement, Background Radiation Sources, Radiation Shielding, and Alpha, Beta, and Gamma.

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This book is written specifically for students in grades 6–8. It contains 38 experiments in Earth science, life science, and physical science. See page 68.

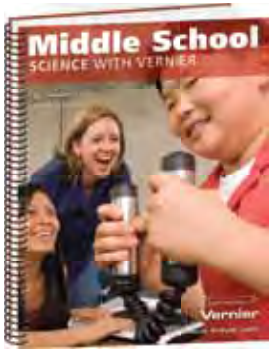
b. *Forensics with Vernier,* ORDER CODE **FWV, $30**
This book is for teachers at the high school level who wish to introduce their students to forensics using engaging and realistic laboratory activities with Vernier probeware. The book contains 14 lab activities for computer and LabQuest only.

c. *Earth Science with Vernier,* ORDER CODE **ESV, $48**
This book contains 33 experiments and 6 projects. Topics include geology, soil analysis, water quality, hydrology, oceanography, meteorology, and energy. See page 52.

d. *Physical Science with Vernier,* ORDER CODE **PSV, $48**
This book contains 40 experiments for physical science (middle school through grade 10). These experiments are perfect for introductory physical science and integrated science classes. See page 74.

e. *Agricultural Science with Vernier,* ORDER CODE **AWV, $48**
This lab book contains experiments specifically chosen for teaching topics in agricultural science at the high school or college level. Experiments range from the investigation of factors affecting transpiration, to the temperature effect shearing has on sheep, to the development of an understanding of Ohm's law.

f. *Elementary Science with Vernier,* ORDER CODE **EWV, $48**
This book contains 43 fun and engaging experiments for elementary students. Activities investigate temperature, motion, force, magnetism, light, electricity, and pressure. This book is for data collection on computers and LabQuest only. See page 70.



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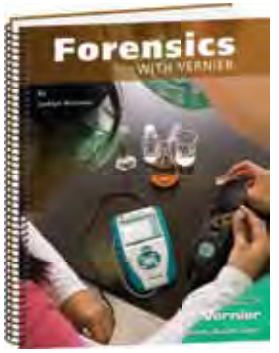

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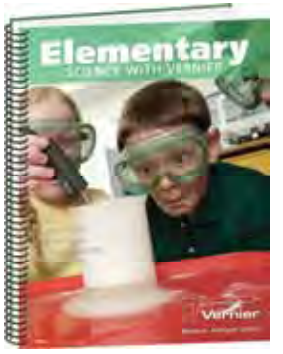

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VERNIER TEXTBOOK CORRELATIONS

Vernier lab activities are matched to the tables of contents in dozens of popular textbooks. Check out the Vernier textbook correlations to see how easy it is for you to integrate technology into your curriculum.

MORE ONLINE – For more information, go to **www.vernier.com/textbook-correlations**

View specific textbook information

Easily identify correlated Vernier lab books

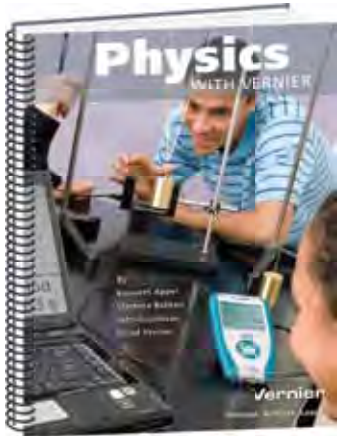
Detailed correlation report includes your textbook's chapter number and title, along with the correlated Vernier experiment title and sensor used.

Many popular science textbooks have already been correlated.

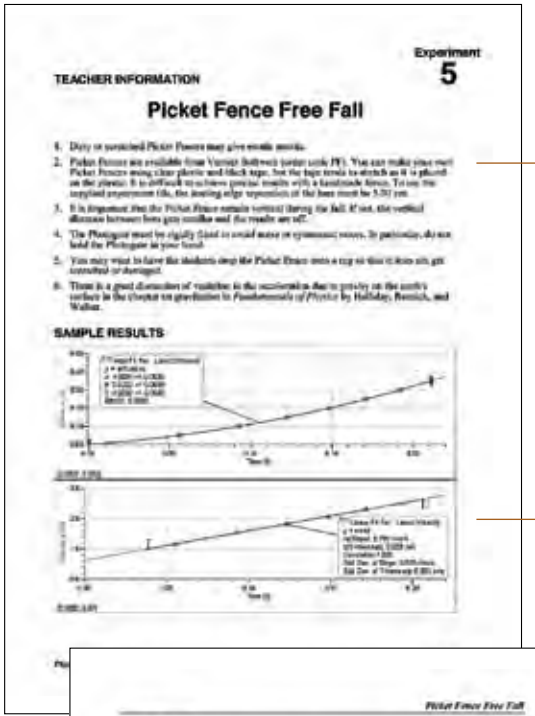
Browse correlated textbooks by subject area or publisher name

Lab Book Features

From *Physics with Vernier* lab book



***CD includes easy-to-edit Word files** for the student experiments, and instructions for LabQuest, computers, and calculators, unless otherwise noted*


Experiment 5

TEACHER INFORMATION

Picket Fence Free Fall

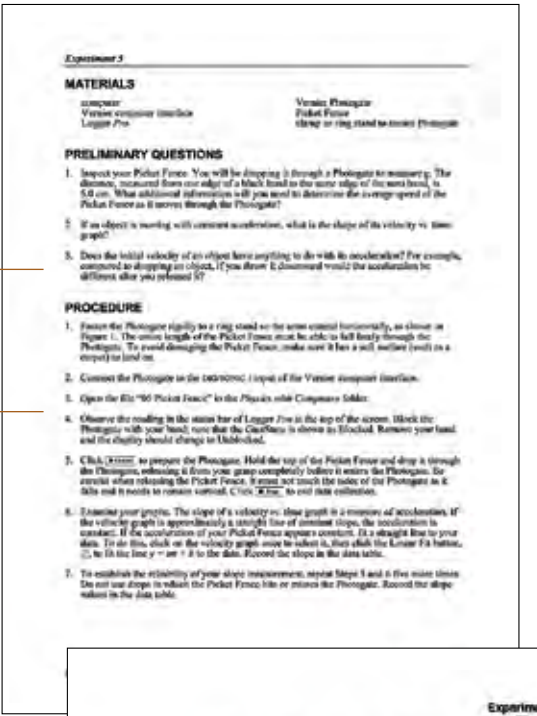
SAMPLE RESULTS

***Detailed teacher information** helps experiments run smoothly*

***Preliminary questions** promote inquiry-based experiments*

*Procedures give **detailed instructions***

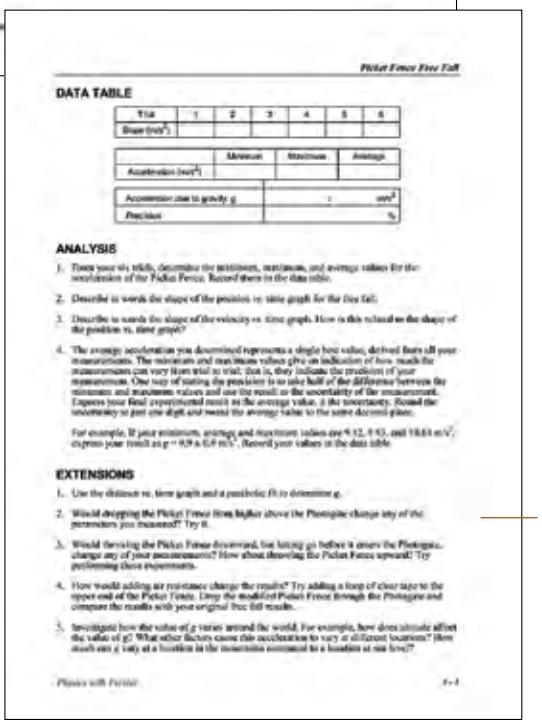
***Sample data and graphs** let instructors see expected results*


Experiment 5

MATERIALS

PRELIMINARY QUESTIONS

PROCEDURE


DATA TABLE

ANALYSIS

EXTENSIONS

***Background information** reinforces the scientific concepts behind the experiment and helps enrich the laboratory experience*

***Clear illustrations** help students visualize the experiment*

***Extensions** provide suggestions for further investigation*

***Concise objectives** specify desired student performance*

Experiment 5

Picket Fence Free Fall

OBJECTIVE

Helping You Meet Content Standards

Vernier understands that meeting curriculum standards is an important part of today's teaching. As state and federal requirements change, we are committed to providing you with the most current information. You will find the following alignments to standards on our web site, **www.vernier.com/standards**, for all lab books published by Vernier:

- Science standards for all 50 U.S. states
- Provincial standards for Canada
- NCTM (National Council for Teachers of Mathematics)
- AP and IB
- NSES (National Science Education Standards)
- ISTE (International Society for Technology Educators)

VERNIER STANDARDS CORRELATION FOR YOUR STATE

Choose the book you'd like to correlate

Choose the standard to which you'd like to correlate

MORE ONLINE – For more information, go to **www.vernier.com/standards/**

VERNIER LAB BOOKS ARE A GREAT VALUE

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive:

- Essential teacher information.
- Ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, LabQuest Mini, computer, and calculator versions on CD, unless otherwise noted.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft Word files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/labs**

TRAINING VIDEOS ONLINE – Watch training videos and download free activities at **www.vernier.com/videos**

My LabQuest Library

Vernier has embedded over 100 of our most popular science experiments into LabQuest. My LabQuest Library allows you to create, customize, organize, and download labs to LabQuest for the entire class.

www.vernier.com/mylabquest

LAB CREATOR

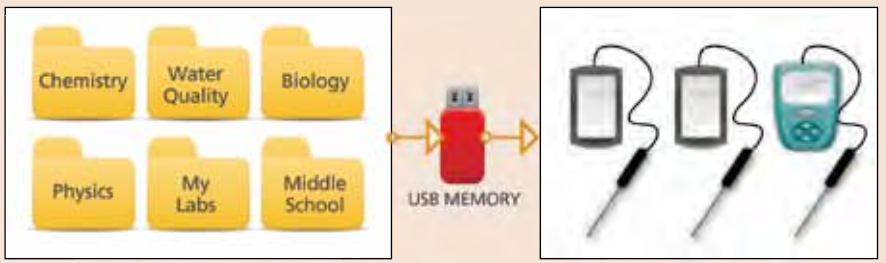
Create your own labs with the Lab Creator

This **FREE** custom application allows you to create and easily upload your labs to LabQuest.

LAB ORGANIZER

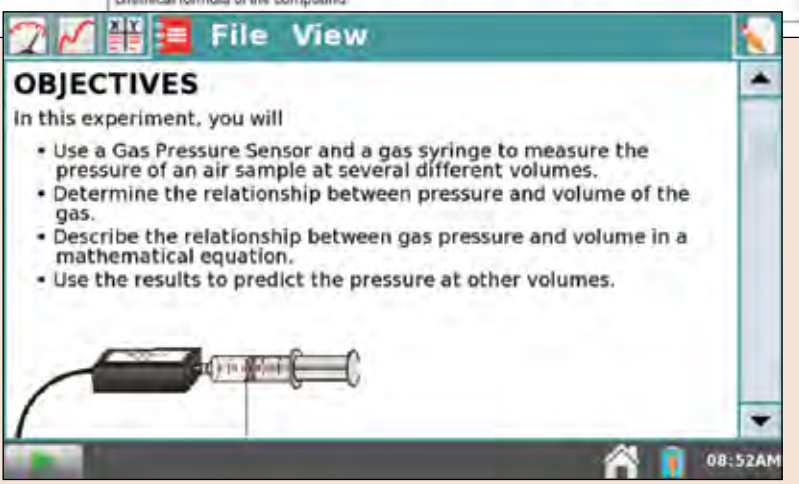
Customize your LabQuest with the Lab Organizer

In addition to our 100 most popular labs that are preloaded, more than 400 Vernier experiments from 16 lab books are available for you to upload to your LabQuest units!



MY LABQUEST LIBRARY
LAB CREATOR
Create custom labs for your LabQuest
Choose Starting Point
Create Your Lab
Preview Your Lab
Name Your Lab
Download Your Lab
Create Your Lab
Start with a Blank Lab
Use this web-based editor to write a lab or paste an existing lab from a document on your computer.
Important Tips
Click icon to show tips for common tasks.
What is the best way to copy and paste a lab from Microsoft Word to Lab Creator?
How do I transfer images from my Microsoft Word document to Lab Creator?
How do I add saved images to Lab Creator?
How do I change a numbered list to a lettered list?
The Determination of a Chemical Formula
John Dalton was an Englishman, a teacher, and an exceptional theoretical chemist. He developed and wrote the modern atomic theory at the turn of the 19th century (documents point to 1803). He was influenced by the experiments of two Frenchmen, Antoine Lavoisier and Joseph Louis Proust. A fundamental component of the modern atomic theory is that the mole ratios of elements in a compound will be small whole numbers (law of definite proportions). The whole number mole ratio is commonly referred to as the empirical formula of a compound.
One of the challenges in finding the proper chemical formula for a compound is that there may be more than one plausible mole ratio for the elements in that compound. Dalton called this the law of multiple proportions. For example, if you were testing a compound that contained iron and sulfur, the plausible chemical formula could be FeS or Fe_2S_3. However, if you determine the mass of iron and the mass of sulfur present in a given mass of the compound, you will be able to establish the true chemical formula of the compound.

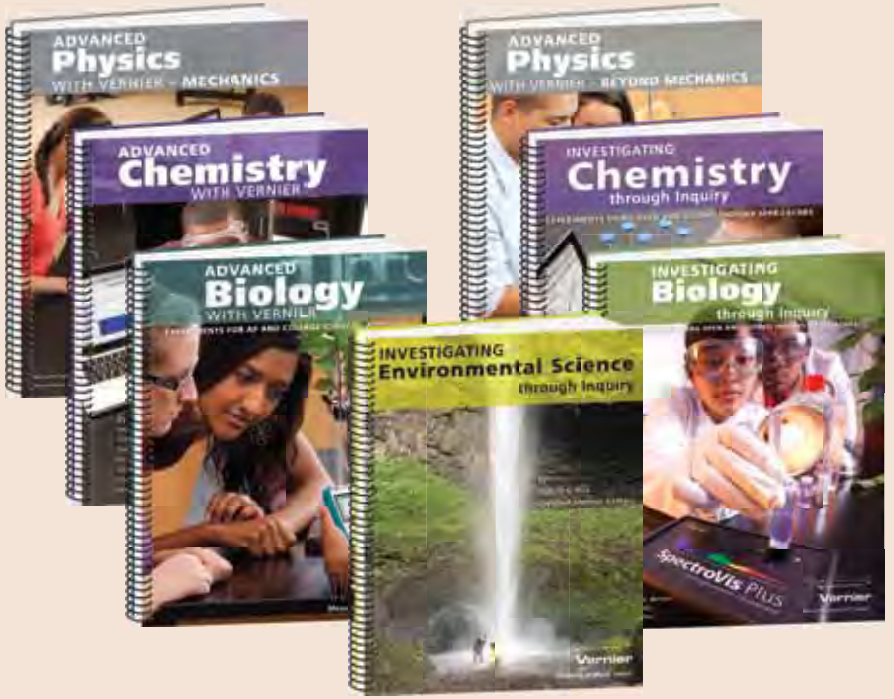
Create your custom lab with the Lab Creator.


File View
OBJECTIVES
In this experiment, you will
• Use a Gas Pressure Sensor and a gas syringe to measure the pressure of an air sample at several different volumes.
• Determine the relationship between pressure and volume of the gas.
• Describe the relationship between gas pressure and volume in a mathematical equation.
• Use the results to predict the pressure at other volumes.
08:52AM

Download it to your LabQuest.

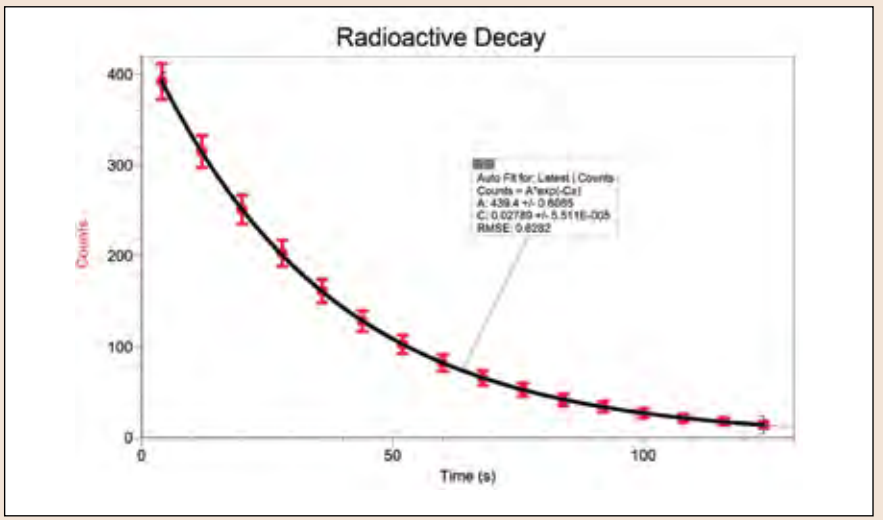
Your Complete Solution for AP* and IB† Science

CURRICULUM



- Correlations to AP and IB standards for biology, chemistry, physics, and environmental science
- Editable Word files for all student pages, so you can customize the labs to meet your standards
- ICT support for the IB Group 4 sciences
- Questions promote higher-order thinking skills
- Lab extensions encourage inquiry investigations

SOFTWARE



Logger *Pro* 3, ORDER CODE **LP, $229,** One CD for Mac OS X and Windows

- Manual configuration mode allows students to set all data-collection parameters
- Error bars
- Log and semi-log graphs
- Modeling
- Custom curve fits
- Double y-graphs
- Gel analysis
- Peak integration on GC data
- Export data to Google Maps or GIS
- Spectrometer data analysis
- Video analysis

See pp. 18–21 for details.

IB Standards All IB Group 4 experimental science courses now require students to use sensors for data logging in an experiment and software for graph plotting. For IB correlations, visit **www.vernier.com/ib**

*AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

†The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

Additional information on data-collection packages for AP and IB science can be found on the following pages:

Advanced Biology – page 29
Advanced Chemistry – page 43
Advanced Physics – pp. 81, 83
Environmental Science – page 65

Versatile Solution for Calculator and Computer Data Collection

$220 ORDER CODE LABPRO

Three different ways to collect data! You can use LabPro with a computer, Texas Instruments graphing calculator, or on its own as a remote data collector.

- Multi-channel interface
- 68 **Vernier sensors** are compatible with the LabPro
- Six data-collection channels allow you to use multiple sensors at once
- Samples up to 50,000 readings per second

Included with LabPro: LabPro unit, power adapter, USB computer cable, calculator cable, calculator cradle, DataMate calculator program, users manual, voltage probe

AAPT Most Innovative New Product Award

For more information on curricular materials and sensors appropriate for your subject area, see:

23–36 Biology
37–51 Chemistry
52–55 Earth Science
64–66 Environmental Science
67–71 K-8 Science
72–73 Math
74–76 Physical Science
77–95 Physics
96–97 Science Department
98–99 Water Quality

See page 109 for a list of sensors compatible with LabPro.

LABPRO FEATURES

COMPATIBILITY

- Windows or Macintosh computers via USB with Logger *Pro* or Logger Lite software
- TI graphing calculators: All current TI graphing calculators except TI-Nspire and TI-Nspire CAS

SIX DATA-COLLECTION CHANNELS

- Four channels for 58 different sensors, including temperature, dissolved oxygen, gas pressure, pH, force, and more
- Two channels for motion detectors, photogates, radiation monitor, rotary motion sensor, drop counter, digital control unit and more.

SENSOR COMPATIBILITY

- Supports our auto-ID sensors or can be used with our older sensors using the appropriate adapters.

UPGRADEABLE

- LabPro's flash memory means that new features can easily be added as they become available. Simply download and install the new operating system from our web site…**FREE!**

SAMPLING

- Samples up to 50,000 readings per second
- 12-bit A/D conversion
- Internally stores 12,000 data points

DIGITAL LINES

- 8 TTL input/output lines (4 on each DIG/SONIC port)

ANALOG OUTPUT

- 1 channel, ±4 volts, 100 mA (with function generator)

Collecting and analyzing sound data using a TI-84 running EasyData, a LabPro, and a Microphone

A pH titration using a LabPro, pH Sensor, Vernier Drop Counter, and a Vernier Stir Station

LABPRO COMPATIBLE SENSORS

SENSOR	CODE	PRICE
Accelerometers		
3-Axis Accelerometer	3D-BTA	$99
25-g Accelerometer	ACC-BTA	$92
Low-g Accelerometer	LGA-BTA	$89
Anemometer	ANM-BTA	$89
Barometer	BAR-BTA	$71
Blood Pressure Sensor *	BPS-BTA	$105
Charge Sensor	CRG-BTA	$75
CO_2 Gas Sensor	CO2-BTA	$249
Colorimeter	COL-BTA	$115
Conductivity Probe	CON-BTA	$95
Constant Current System	CCS-BTA	$59
Current Probes		
Current Probe	DCP-BTA	$39
High Current Sensor	HCS-BTA	$79
Diffraction Apparatus *	DAK	$549
Digital Control Unit †	DCU-BTD	$61
Dissolved Oxygen Probes		
Dissolved Oxygen Probe	DO-BTA	$209
NEW Vernier Optical DO Sensor	ODO-BTA	$379
Drop Counter †	VDC-BTD	$99
Dual-Range Force Sensor	DFS-BTA	$109
EKG Sensor	EKG-BTA	$147
Electrode Amplifier	EA-BTA	$40
NEW Ethanol Sensor †•	ETH-BTA	$109

SENSOR	CODE	PRICE
Flow Rate Sensor	FLO-BTA	$129
Force Plate	FP-BTA	$225
Gas Pressure Sensor	GPS-BTA	$83
NEW Goniometer	GNM-BTA	$159
Hand Dynamometer	HD-BTA	$99
Hand-Grip Heart Rate Monitor	HGH-BTA	$119
Instrumentation Amplifier	INA-BTA	$59
Ion-Selective Electrodes		
Ammonium Ion-Selective Electrode	NH4-BTA	$179
Calcium Ion-Selective Electrode	CA-BTA	$179
Chloride Ion-Selective Electrode	CL-BTA	$179
Nitrate Ion-Selective Electrode	NO3-BTA	$179
Light Sensor	LS-BTA	$55
Magnetic Field Sensor	MG-BTA	$58
Melt Station †•	MLT-BTA	$449
Microphone	MCA-BTA	$39
Motion Detector	MD-BTD	$79
O_2 Gas Sensor	O2-BTA	$188
ORP Sensor	ORP-BTA	$79
pH Sensor	PH-BTA	$79
Tris-Compatible Flat pH Sensor	FPH-BTA	$99
Photogate †	VPG-BTD	$45
Polarimeter (Chemical) *†	CHEM-POL	$499
Power Amplifier †	PAMP	$199
Vernier Projectile Launcher †	VPL	$299

SENSOR	CODE	PRICE
NEW Pyranometer	PYR-BTA	$199
Radiation Monitors		
Radiation Monitor † (Digital)	DRM-BTD	$299
NEW Vernier Radiation Monitor †	VRM-BTD	$169
Relative Humidity Sensor	RH-BTA	$69
Respiration Monitor Belt *(requires GPS-BTA)*	RMB	$63
Rotary Motion Sensor †	RMV-BTD	$169
Salinity Sensor	SAL-BTA	$92
Soil Moisture Sensor	SMS-BTA	$95
Sound Level Meter	SLM-BTA	$165
Spirometer	SPR-BTA	$199
Temperature Probes		
Extra-Long Temperature Probe	TPL-BTA	$79
Infrared Thermometer	IRT-BTA	$169
Stainless Steel Temperature Probe	TMP-BTA	$29
Surface Temperature Sensor	STS-BTA	$23
Thermocouple	TCA-BTA	$69
Wide-Range Temperature Probe •	WRT-BTA	$79
Turbidity Sensor	TRB-BTA	$112
UVA Sensor	UVA-BTA	$106
UVB Sensor	UVB-BTA	$107
Voltage Probes		
Differential Voltage Probe	DVP-BTA	$39
Voltage Probe	VP-BTA	$12
30-Volt Voltage Probe •	30V-BTA	$49

* Use with computers only † Not supported with Logger Lite software • Calculators require EasyData v2.4 or higher.

TI-Nspire™ Technology for Math and Science

The TI-Nspire product line includes handhelds and software that provide teachers with flexibility and versatility to meet different needs in math and science classrooms. These learning tools allow students to:

- See algebraic, graphical, geometric, numeric, and written representations.
- Link different representations of a problem.
- Use built-in interactive geometry.
- Enter and review expressions and formulas as seen in a textbook.
- Explore topics from algebra to calculus.
- Collect real-world data with Vernier sensors.

Two different handhelds, TI-Nspire and TI-Nspire CAS, are available.

The TI-Nspire CAS handheld includes built-in CAS (Computer Algebra System) capabilities, which enables students to explore and manipulate mathematical expressions in symbolic form.

Computer versions of TI-Nspire software and TI-Nspire CAS software are also available.

SAVE $ with multi-user software licenses!
Go to **www.vernier.com/ti-nspire-licenses**

TI-NSPIRE PRODUCTS

TI-Nspire CX Handheld, ORDER CODE **TI-NSCX, $135**
Includes TI-Nspire CX handheld, rechargeable battery, and AC wall adapter.

TI-Nspire CX Teacher Bundle, ORDER CODE **TI-NSCX-TB, $203**
Includes TI-Nspire CX handheld, rechargeable battery, AC adapter, and a single license of TI-Nspire Teacher Edition software.

TI-Nspire CX School Pack, ORDER CODE **TI-NSCX-TPK, $1,469**
Includes 10 TI-Nspire CX EZ Spot handhelds with the words "School Property" on the keypad, 10 rechargeable batteries, and a 10-unit docking station.

TI-Nspire Computer Software – single-user license

TI-Nspire computer software and the TI-Nspire learning handheld share the same set of functionality, so you and your class can use either as a standalone learning tool.

Student Software, ORDER CODE **TI-NSSW-1, $76**
Teacher Software, ORDER CODE **TI-N2T-SP-KT, $135**
Teacher software includes license for both TI-Nspire and TI-Nspire CAS teacher software.

TI-NSPIRE CAS PRODUCTS

TI-Nspire CX CAS Handheld, ORDER CODE **TI-NSCXCAS, $138**
Includes a TI-Nspire CX CAS handheld, rechargeable battery, AC wall adapter.

TI-Nspire CX CAS Teacher Bundle,
ORDER CODE **TI-NSCXCAS-TB, $206**
Includes TI-Nspire CX CAS handheld, rechargeable battery, AC adapter, and a single license of TI-Nspire CAS Teacher Edition software.

TI-Nspire CX CAS School Pack
ORDER CODE **TI-NSCXCAS-TPK, $1,499**
Includes 10 TI-Nspire CAS handhelds, 10 rechargeable batteries, and a 10-unit docking station.

TI-Nspire CAS Computer Software – single user license
TI-Nspire CAS Computer Software is designed for algebra through calculus. It contains Computer Algebra System functionality.

Student Software, ORDER CODE **TI-NSCASSW-1, $78**
Teacher Software, ORDER CODE **TI-N2T-SP-KT, $135**
Teacher software includes license for both TI-Nspire and TI-Nspire CAS teacher software.

$135
ORDER CODE
TI-NSCX

$138
ORDER CODE
TI-NSCXCAS

"I am really impressed with the DataQuest application Vernier developed. It is a very nice app. Using it in such an integrated way with the other apps built into the TI-Nspire is very cool. I love the Boyle's law file from TI's Science Nspired web site with the added interactive animations and student input pages. WOW!"

Nüsret Hisim, Walkersville High School
Walkersville, Maryland

Data Collection with TI-Nspire™ Technology

Vernier and Texas Instruments have teamed up to provide a full-featured, data-collection solution for TI-Nspire technology. It starts with the Vernier DataQuest Application, a built-in App found in the TI-Nspire handheld and computer software (v3.0 and newer*). Now add the TI-Nspire Lab Cradle, a multi-channel sensor interface that supports 66 Vernier sensors. Use this powerful combination to bring real-world data to your science and math classroom.

TI-Nspire™ Lab Cradle, ORDER CODE **TI-NSLABC, $145**
The TI-Nspire Lab Cradle from Texas Instruments is a multi-channeled data-collection interface for use with TI-Nspire technology (sold separately). The Lab Cradle has five sensor ports for use with 66 Vernier sensors. (For a complete list of supported sensors, see pp. 118–119.) Collect data up to 100,000 samples per second. The Lab Cradle is compatible with TI-Nspire computer software and handhelds running software version 3.0 or newer. The Lab Cradle includes a rechargeable battery and AC Adaptor.

TI-Nspire™ Lab Cradle Bundle, ORDER CODE **TI-NSLABC-5, $725**
Includes 5 TI-Nspire Lab Cradles with rechargeable batteries, and a 5-unit charging bay.

THE DATAQUEST™ APPLICATION FROM VERNIER

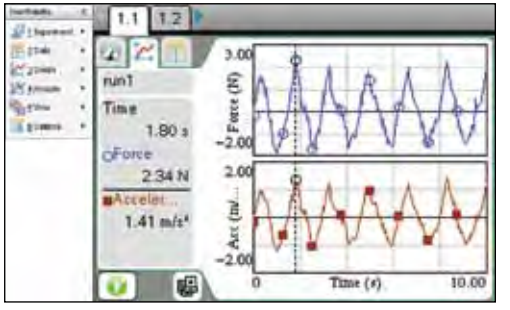
The DataQuest App is our full-featured data-collection and analysis application for TI-Nspire technology.

Key Features

- Meter, Graph, and Table views—all in the same application
- Supports TI-Nspire™ Lab Cradle, EasyLink, and Go!Link sensor interfaces
- Supports EasyTemp, Go!Temp, CBR 2, and Go!Motion
- Collect data with 66 Vernier sensors
- Manually enter data for analysis
- Analysis features:
  - Curve fitting: 11 fits, including proportional and natural exponent
  - User-defined modeling
  - Tangent, integral, statistics
  - Draw predictions
  - Position and velocity motion matching
- Included free with TI-Nspire software*, version 3.0 or newer

*The TI-Nspire software is a free upgrade for all existing TI-Nspire users.

$145 ORDER CODE **TI-NSLABC**



TI-Nspire Data-Collection Packages for Science

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

TI-Nspire

TI-Nspire Handhelds or Computer Software

INTERFACE AND SENSORS	CODE	Starter Package LC-SCI-ST	Deluxe Package LC-SCI-DX
TI-Nspire Lab Cradle	**TI-NSLABC**	$145	$145
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Motion Detector	MD-BTD	$79	$79
Conductivity Probe	CON-BTA	$95	$95
pH Sensor	PH-BTA	$79	$79
Gas Pressure Sensor	GPS-BTA	$83	$83
Magnetic Field Sensor	MG-BTA	$58	$58
Dual-Range Force Sensor	DFS-BTA	$109	$109
Microphone	MCA-BTA	$39	$39
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	$119
Dissolved Oxygen Probe	DO-BTA		$209
Colorimeter	COL-BTA		$115
Low-g Accelerometer	LGA-BTA		$89
CO_2 Gas Sensor	CO2-BTA		$249
Light Sensor	LS-BTA		$55
Differential Voltage Probe	DVP-BTA		$39
PACKAGE PRICE		**$835**	**$1,591**
Save when you purchase sets of 5 (includes Lab Cradle Bundle – see page 111)		**LC-SCI-ST5 $4,072**	**LC-SCI-DX5 $7,738**

DELUXE

STARTER

YOU WILL ALSO NEED:

***Science with TI-Nspire Technology* lab book**
See below. ORDER CODE **SWN, $48**

TI-Nspire Handheld or Computer Software
See page 110.

SCIENCE WITH TI-NSPIRE™ TECHNOLOGY ORDER CODE SWN, $48

This book is written for students doing data collection with TI-Nspire handhelds and software. It contains 33 experiments in Earth/environmental science, biology, chemistry, and physics.

☐ ☐ **TEMPERATURE PROBE**
- Intro to Data Collection
- Soil Temperature*
- Water Quality
- Reflection and Absorption of Light*†
- Dew Point
- Seasons and Angle of Insolation
- Freezing and Melting of Water
- Evaporation and Intermolecular Attractions
- Hess's Law

☐ ☐ **MOTION DETECTOR**
- Graph Matching
- Ball Toss
- Static and Kinetic Friction*
- Simple Harmonic Motion

☐ ☐ **CONDUCTIVITY PROBE**
- Water Quality
- Diffusion through Membranes
- Conducting Solutions
- Properties of Solutions
- Conductivity of Solutions

☐ ☐ **pH SENSOR**
- Water Quality
- Acids and Bases
- Interdependence of Plants and Animals*†
- Acid Rain

☐ ☐ **GAS PRESSURE SENSOR**
- Enzyme Action
- Transpiration
- Boyle's Law

☐ ☐ **MAGNETIC FIELD SENSOR**
- Exploring Magnetism
- Where Is North?

☐ ☐ **DUAL-RANGE FORCE SENSOR**
- Newton's Second Law*†
- Static and Kinetic Friction*

☐ ☐ **MICROPHONE SENSOR**
- Sound Waves and Beats
- Speed of Sound

☐ ☐ **HAND-GRIP HEART RATE MONITOR**
- Heart Rate and Physical Fitness
- Ventilation and Heart Rate

☐ ☐ **DISSOLVED OXYGEN PROBE**
- Water Quality
- Interdependence of Plants and Animals*

☐ ☐ **COLORIMETER**
- Beer's Law

☐ ☐ **LOW-G ACCELEROMETER**
- Newton's Second Law*

☐ ☐ **CO_2 GAS SENSOR**
- Cell Respiration

☐ ☐ **LIGHT SENSOR**
- Reflection and Absorption of Light*

☐ ☐ **DIFFERENTIAL VOLTAGE PROBE**
- Capacitors

☐ STARTER PACKAGES ☐ DELUXE PACKAGES

*Activity Requires TI-Nspire Lab Cradle †Activity Requires a Sensor from the Deluxe Package

TI-Nspire Data-Collection Packages for Math

Purchase one package per group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

TI-Nspire

TI-Nspire Technology (Handhelds or Computer Software)

INTERFACE & SENSORS	CODE	Starter Package LC-MATH-ST	Deluxe Package LC-MATH-DX
TI-Nspire Lab Cradle	**TI-NSLABC**	$145	$145
Motion Detector	MD-BTD	$79	$79
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
TI Light Probe	TILT-BTA	$13	$13
Voltage Probe	VP-BTA	$12	$12
pH Sensor	PH-BTA		$79
Dual-Range Force Sensor	DFS-BTA		$109
Microphone	MCA-BTA		$39
PACKAGE PRICE		**$361**	**$588**
Save when you purchase sets of 5 (Includes Lab Cradle Bundle – see page 111)		**LC-MATH-ST5 $1,775**	**LC-MATH-DX5 $2,876**

DELUXE

STARTER

YOU WILL ALSO NEED:

Real-World Math with Vernier activity book
ORDER CODE **RWV, $48** See below.

TI-Nspire Handheld or computer software. See page 110.

REAL-WORLD MATH WITH VERNIER

ORDER CODE **RWV, $48**

This book contains 32 ready-to-use student versions of calculator activities in print.

☐ **USING A MOTION DETECTOR**
- Straight Line Distance Graphs
- Newton's Second Law†
- The Linear Force Relation for a Rubber Band†
- Position and Time for a Cart on a Ramp
- Height and Time for a Bouncing Ball
- Definition of Rate
- Interpreting Velocity Graphs
- Applications of the Distance Formula
- Exponential Pattern of Rebound Heights
- Pendulum Motion
- Damped Harmonic Motion
- Describing Data With Statistical Plots
- Solving a System of Linear Equations
- Plotting an Ellipse
- Parametric Plots
- Piecewise-Defined Functions
- Greatest Integer Functions
- Period and Length of a Simple Pendulum

☐ **USING A LIGHT SENSOR**
- Distance and Intensity
- Periodic Phenomena

☐ **USING A TEMPERATURE PROBE**
- Mixing Liquids of Different Temperatures
- How Hot Objects Cool
- Describing Data with Statistics

☐ **USING A VOLTAGE PROBE**
- Exponential Models

☐ **USING A GAS PRESSURE SENSOR**
- Linear Relationship between Water Depth and Pressure
- Linear Rates of Pressure Increase
- The Inverse Relationship between Pressure and Volume

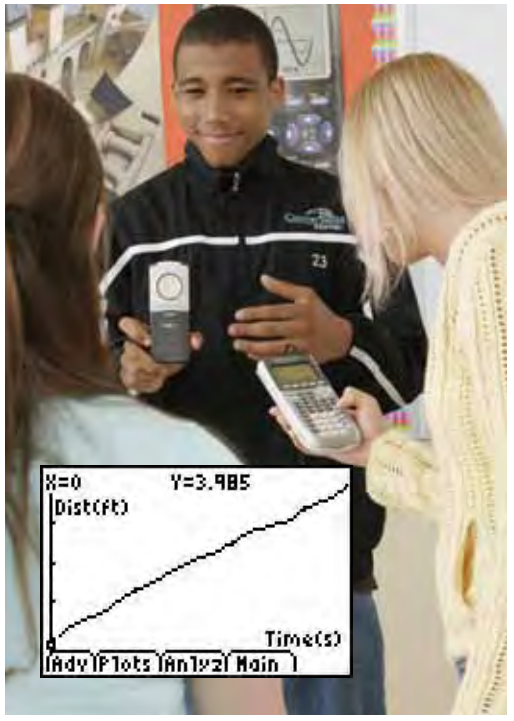
☐ **USING A MICROPHONE**
- Sound Waveform Models

☐ **USING A FORCE SENSOR**
- Linear Relationship between Weight and Quantity
- Volume and Weight
- Newton's Second Law
- The Linear Force Relation for a Rubber Band

☐ **USING A pH SENSOR**
- The Exponential pH Change
- An Application of the Logistic Function

† Requires Deluxe Package

☐ STARTER PACKAGES ☐ DELUXE PACKAGES



Graphing constant motion

$38 (a)

$99 (b)

Direct-Connect Sensors

Direct-connect sensors can be used with supported TI calculators without an interface. All other Vernier sensors require a sensor interface.

a. Vernier EasyTemp
ORDER CODE **EZ-TMP, $38**

The Vernier EasyTemp is inexpensive and easy to use! What more can you ask for? Plug Vernier EasyTemp into the USB port on a TI-84 Plus calculator or TI-Npsire handheld*. The data-collection application automatically launches, and you are ready to collect data! This stainless steel probe is durable for classroom use and covers a temperature range of –20°C to 115°C.

* EasyTemp can only be used with TI-84 and TI-Nspire handhelds.

b. CBR 2, ORDER CODE CBR2, $99

If you teach math, physical science, or physics, consider the CBR 2. The CBR 2 collects distance, velocity, and acceleration data. It connects directly to a TI calculator. When the CBR 2 is connected to the USB port of a TI-84 Plus calculator or TI-Npsire handheld, the data-collection application automatically launches, and you are ready to collect data.

INTERFACES

We offer several interface options for data collection for different budgets and classroom setups. For a detailed comparison of your interface options, see **www.vernier.com/calculator-interfaces**

Vernier LabPro® — $220 ORDER CODE LABPRO

The Vernier LabPro Interface is our full-featured, data-collection interface offering everything that you need for data collection with a TI graphing calculator. LabPro can also be connected to a computer for additional data-collection options.

For more information go to **www.vernier.com/labpro**

Texas Instruments CBL 2 — $166 ORDER CODE CBL2

The CBL 2 is an easy-to-use, powerful, and inexpensive data-collection tool. The CBL 2 System includes the CBL 2 interface, a Stainless Steel Temperature Probe, TI Light Probe, Voltage Probe, calculator cradle, link cable, batteries, user's guide, and a TI resource CD.

Over 60 Vernier sensors can be connected to the CBL 2.

Vernier EasyLink™ — $59 ORDER CODE EZ-LINK

With the Vernier EasyLink, data collection with a TI graphing calculator is easier and more affordable.

EasyLink is a single-channel interface that plugs into the USB port of a TI-84 graphing calculator or TI-Nspire Handheld. It supports any one of **53 Vernier sensors**.

Priced at only $59, EasyLink is an affordable way to get started with calculator-based data collection!

NEW EASYDATA 2.4 / 4.0

We have updated the EasyData App for the TI-83/84 Plus family of graphing calculators.

EasyData 2.4 supports:
- TI-83 Plus, TI-83 Plus Silver Edition, TI-84 Plus, and TI-84 Plus Silver Edition

EasyData 4.0 supports:
- NEW TI-84 Plus C Silver Edition (comes preloaded on calculator)

EasyData 2.4 and 4.0 new features include:
- Support for additional sensors
  - 30-Volt Voltage Probe
  - Wide-Range Temperature Probe
  - Vernier Melt Station
  - Ethanol Sensor
  - Vernier Optical DO Probe
- Manual scaling of graph from within the App
- Manual setup of Live Graph Scaling
  - includes option to turn off Auto Scale

EasyData 4.0 only features include:
- Support for the TI-84 C high-resolution, color screen
- Sensor meters and graphs use color to identify different data columns

FREE download at **www.vernier.com/easydata**

Exponential cooling curve

TI Graphing Calculators

TI graphing calculators are valuable tools in math and science. For middle school, we recommend the TI-73 Explorer (see page 116) or the TI-84 Plus family of calculators. For high school, we recommend the TI-84 or the TI-Nspire (see page 110) family of calculators. These calculators can be purchased individually or in convenient teacher packs of 10 calculators.

a. NEW TI-84 Plus C Silver Edition, ORDER CODE TI-84C, $129

Introducing the next generation of the popular TI-84 Plus family of graphing calculators! The TI-84 C has a full-color, high-resolution, backlit screen, making it easy to read. The calculator comes with a rechargeable battery, so there is never a need to buy AAA batteries. Import real-world images as a graph background for analysis of features found in the image. Use with Vernier EasyData 4.0 for data collection with 64 Vernier sensors to investigate concepts in math and science. The TI-84 C has the same menu structure, navigation and applications, making the transition from a TI-83/84 seamless.

Features include:

- High-resolution, backlit, full-color display
- Built-in rechargeable battery
- Familiar TI-84 Plus functionality
- Import digital images (jpg, jpeg, bmp, and png)
- MathPrint™ option to see expressions as they appear in textbooks

Also available in a Teacher Pack of 10 handhelds that includes 10 EZ-Spot calculators and a 10 unit charging station.

TI-84 Plus C Teacher Pack, ORDER CODE TI-84C-TPK, $1,345

b. TI-84 Plus, ORDER CODE TI-84PL, $108

- Over ten preloaded Apps including EasyData and Cabri™ Jr.
- 2.5 times the speed and 3 times the memory of the TI-83 Plus

TI-84 EZ Spot Teacher Pack, ORDER CODE TI-84SPOTTP, $1,080

c. TI-84 Plus Silver Edition, ORDER CODE TI-84PSE, $125

- More than 20 preloaded Apps, including EasyData, Cabri™ Jr., and Periodic Table
- 2.5 times the speed and 9 times the memory of the TI-83 Plus

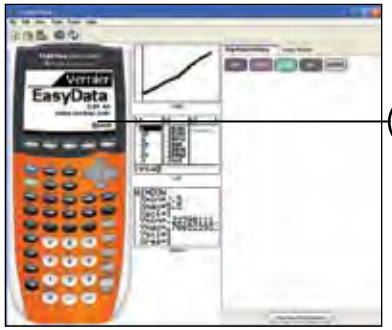
TI-84 Plus Silver Edition EZ Spot Teacher Pack
ORDER CODE TI-84SESPTP, $1,250

a $129

Available Spring 2013

b $108

c $125



Save $$ with multi-user licenses of SmartView software.
See **www.vernier.com/ti-smartview**

$66 b

$98 c

a. TI-SmartView™ Emulator Software

ORDER CODE **TI-SV, $135** *(Single-user license)*

TI-SmartView lets you project an interactive representation of a TI-84 Plus calculator to your entire class. You can use TI-SmartView to project multiple representations simultaneously (graphs, window settings, tables), display key press history, and capture multiple screenshots. TI-SmartView is ideal for use with interactive whiteboards. TI-SmartView can be used with Vernier LabPro, TI CBL 2, or CBR 2 data-collection devices. This capability requires a TI USB Connectivity Kit (not included).

b. TI-73 Explorer Graphing Calculator

ORDER CODE **TI-73EX, $66**

Recommended for Middle School. A simple keypad makes it easier for younger students to use. The TI-73 Explorer is electronically upgradable.

TI-73 Explorer Teacher Pack

ORDER CODE **TI-73EXTP, $660**

A teacher pack for the TI-73 Explorer calculator is available. Each teacher pack includes 10 calculators, 40 batteries, 5 unit-to-unit cables, a USB TI-Connectivity cable, a calculator poster and transparency, and a manual.

c. TI-83 Plus Graphing Calculator

ORDER CODE **TI-83PL, $98**

Low-cost choice for use in high school science and math courses. The TI-83 Plus contains Flash ROM technology.

TI-83 Plus Teacher Pack

ORDER CODE **TI-83PLTP, $980**

A teacher pack for the TI-83 Plus calculator is available. Each teacher pack includes 10 calculators, 40 batteries, 5 unit-to-unit cables, a USB TI-Connectivity cable, a calculator poster and transparency, and a manual.

CALCULATOR PRODUCTS PRICE LIST

PRODUCT	CODE	PRICE
CBL 2 System	CBL2	$166
Vernier LabPro	LABPRO	$220
Vernier EasyLink	EZ-LINK	$59
EasyTemp	EZ-TMP	$38
TI-Nspire Lab Cradle	TI-NSLABC	$145
TI-Nspire Lab Cradle Bundle *(includes 5 unit Charging Bay)*	TI-NSLABC-5	$725
Calculator-Based Ranger 2	CBR2	$99
TI-73 Explorer Calculator	TI-73EX	$66
TI-73 Explorer Teacher Pack	TI-73EXTP	$660
TI-83 Plus Calculator	TI-83PL	$98
TI-83 Plus Teacher Pack	TI-83PLTP	$980
TI-84 Plus Calculator	TI-84PL	$108
TI-84 Plus EZ Spot Teacher Pack	TI-84SPOTTP	$1,080
TI-84 Plus Silver Edition Calculator	TI-84PSE	$125
TI-84 Plus Silver Edition EZ Spot Teacher Pack	TI-84SESPTP	$1,250
TI-84 Plus C Silver Edition Calculator	TI-84C	$129
TI-84 Plus C Teacher Pack *(includes 10 unit Charging Bay)*	TI-84C-TPK	$1,345
TI-84 Plus C Charging Station	TI-84C-CS	$70
TI-Nspire CX Handheld	TI-NSCX	$135
TI-Nspire CX Teacher Bundle *(handheld & TE software)*	TI-NSCX-TB	$203
TI-Nspire CX School Pack *(10 handhelds & docking station)*	TI-NSCX-TPK	$1,469
TI-Nspire CX CAS Handheld	TI-NSCXCAS	$138
TI-Nspire CX Docking Station	TI-NSCS-DS	$120
TI-Nspire CX CAS Teacher Bundle *(handheld & TE software)*	TI-NSCXCAS-TB	$206
TI-Nspire CX CAS School Pack *(10 handhelds & docking station)*	TI-NSCXCAS-TPK	$1,499
TI-Nspire Navigator for Network Computers	TI-NAVNNC-SP-KT	$1,085
TI-Nspire Student Computer Software *(single license)**	TI-NSSW-1	$72
TI-Nspire CAS Student Computer Software *(single license)**	TI-NSCASSW-1	$77
TI-Nspire Teacher Software *(single license numeric & CAS software)*	TI-N2T-SP-KT	$135
TI USB Connectivity Kit	GLC-USB	$17
Calculator-to-Calculator Link Cable	TI-CLC	$5
Short Calculator Link Cable	TI-SLC	$5
TI Kickstand Slide Cover	TI-KSC	$10
TI SmartView Emulator software for TI-84 *(single-user license)**	TI-SV	$135
Vernier AC Adapter *(for LabPro, CBL 2, CBL)*	IPS	$12
32-User Standard TI-Navigator System	TI-NAV-SD	$3,800
16-User Starter TI-Navigator System	TI-NAV-STR	$2,280
4-User TI-Navigator Add-on *(requires a Navigator system)*	TI-NAV-IND	$450
30-User TI-Nspire CX Navigator System°	TI-NAV-CX30	$2,580
15-User TI-Nspire CX Navigator System°	TI-NAV-CX15	$1,930
5-User TI-Nspire CX Navigator Add-on†°	TI-NAV-CX5	$380
TI-Nspire Navigator Teacher Software Add-on†	TI-NAV-CXSW	$680

† Requires purchase of a Navigator system.
* Lower-price, multi-user license software also available. See **www.vernier.com/ti-nspire-licenses**
° Use with CX handhelds only, sold separately.

TI products purchased in the USA are covered by a one-year warranty based on the date of purchase. Units are warranted against defective materials or workmanship.

TI-NAVIGATOR™ CLASSROOM LEARNING SYSTEMS

The TI-Navigator is a classroom learning system that combines Texas Instruments graphing technology and your classroom PC to create a wireless classroom network. Teachers can assess understanding of key concepts, monitor student progress, and differentiate instruction. The included software supports automatically grading and archiving student work. Learn more at **www.vernier.com/ti-navigator**

a. For TI-83/84* or TI-73 Users

32-User Standard TI-Navigator System
ORDER CODE **TI-NAV-SD, $3,800**

16-User Starter TI-Navigator System
ORDER CODE **TI-NAV-STR, $2,280**

4-User TI-Navigation System Add-on†
ORDER CODE **TI-NAV-IND, $450**

* Cannot be used with TI-84 Plus C Silver Edition calculators
† Add-on pieces require the purchase of a Standard or Starter TI-Navigator System.

b. For TI-Nspire™ CX or TI-Nspire CX CAS Users**

30-User TI-Nspire CX Navigator System,
ORDER CODE **TI-NAV-CX30, $2,580**

15-User TI-Nspire CX Navigator System
ORDER CODE **TI-NAV-CX15, $1,930**

5-User TI-Nspire CX Navigator Add-On‡
ORDER CODE **TI-NAV-CX5, $380**

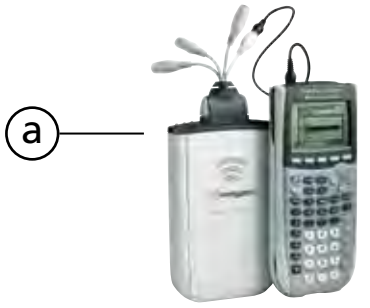
TI-Nspire Navigator Teacher Software Add-On,‡
ORDER CODE **TI-NAV-CXSW, $680**

** This system is for use with TI-Nspire CX handhelds only and will not work with older clickpad or touchpad units.
‡ Add-on pieces require the purchase of a 30-User or 15-User TI-Nspire Navigator system.

c. TI-Nspire Navigator for Networked Computers

ORDER CODE **TI-NAVNNC-SP-KT, $1,085**

Use with TI-Nspire / TI-Nspire CAS student software (not included).



The Vernier Sensor Advantage

OUTSTANDING PERFORMANCE

Vernier sensors are designed specifically for education and held to high standards for quality and durability. With 32 years of experience developing technology for education, we design our sensors for active, hands-on experiments. Vernier sensors are rugged, classroom-proven technology that are well supported and easy to use. The sensors provide consistent, high-quality results for the demands of the classroom.

CONNECT & COLLECT

AUTO ID SENSOR

Just connect and you're ready to collect. All Vernier sensors on the following pages are automatically detected and set up for data collection when used with LabQuest, LabQuest Mini, LabPro, CBL 2, Go!Link, EasyLink, or TI-Nspire Lab Cradle. It's student-friendly technology designed for ease of use.

CURRICULUM ALIGNED TO STATE STANDARDS

Vernier sensors are supported by over 400 detailed, engaging experiments written by teachers, scientists, and technology experts. See how data-collection technology aligns to your curriculum at **www.vernier.com/standards**

GENEROUS WARRANTY

Buy with confidence. Most Vernier sensors are covered by a 5-year warranty. In Vernier's 32 years of business, we have rarely charged a customer for a repair, no matter how old the equipment.

OVER 70 SENSORS AVAILABLE

SENSOR	CODE	PRICE	LABQUEST/ LABQUEST 2	LABQUEST MINI	LABPRO	GO! LINK	EASYLINK	TI LAB CRADLE	PAGE
Accelerometers									
3-Axis Accelerometer	3D-BTA	$99	✔	✔	✔			✔	120
25-g Accelerometer	ACC-BTA	$92	✔	✔	✔	✔	✔	✔	120
Low-g Accelerometer	LGA-BTA	$89	✔	✔	✔	✔	✔	✔	120
Anemometer	ANM-BTA	$89	✔	✔	✔	✔	✔	✔	120
Barometer	BAR-BTA	$71	✔	✔	✔	✔	✔	✔	120
Blood Pressure Sensor	BPS-BTA	$105	✔	✔	✔*	✔	✔°	✔	121
Charge Sensor	CRG-BTA	$75	✔	✔	✔	✔	✔	✔	121
CO_2 Gas Sensor	CO2-BTA	$249	✔	✔	✔	✔	✔	✔	121
Colorimeter	COL-BTA	$115	✔	✔	✔	✔	✔	✔	122
Conductivity Probe	CON-BTA	$95	✔	✔	✔	✔	✔	✔	122
Constant Current System	CCS-BTA	$59	✔	✔	✔	✔	✔	✔	122
Current Probes									
Current Probe	DCP-BTA	$39	✔	✔	✔	✔	✔	✔	123
High Current Sensor	HCS-BTA	$79	✔	✔	✔	✔	✔	✔	123
Diffraction Apparatus	DAK	$549	✔	✔	✔				92
Digital Control Unit	DCU-BTD	$61	✔†	✔	✔			✔	123
Dissolved Oxygen Probes									
Dissolved Oxygen Probe	DO-BTA	$209	✔	✔	✔	✔	✔	✔	124
NEW Vernier Optical DO Probe	ODO-BTA	$379	✔	✔	✔			✔	124
Drop Counter	VDC-BTD	$99	✔	✔	✔			✔	124
Dual-Range Force Sensor	DFS-BTA	$109	✔	✔	✔	✔	✔	✔	124
EKG Sensor	EKG-BTA	$147	✔	✔	✔	✔	✔	✔	125
Electrode Amplifier	EA-BTA	$40	✔	✔	✔	✔	✔	✔	125
NEW Ethanol Sensor	ETH-BTA	$109	✔	✔	✔			✔	125
Flow Rate Sensor	FLO-BTA	$129	✔	✔	✔	✔	✔	✔	126
Force Plate	FP-BTA	$225	✔	✔	✔	✔	✔	✔	126
Gas Pressure Sensor	GPS-BTA	$83	✔	✔	✔	✔	✔	✔	126
NEW Goniometer	GNM-BTA	$159	✔	✔	✔	✔	✔	✔	127
Vernier GPS Sensor	VGPS	$64	✔•		*Computer USB*				127
Hand Dynamometer	HD-BTA	$99	✔	✔	✔	✔	✔	✔	127
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	✔	✔	✔	✔	✔	✔	128
Instrumentation Amplifier	INA-BTA	$59	✔	✔	✔	✔	✔	✔	128
Ion-Selective Electrodes									
Ammonium Ion-Selective Electrode	NH4-BTA	$179	✔	✔	✔	✔	✔	✔	128
Calcium Ion-Selective Electrode	CA-BTA	$179	✔	✔	✔	✔	✔	✔	128
Chloride Ion-Selective Electrode	CL-BTA	$179	✔	✔	✔	✔	✔	✔	128
Nitrate Ion-Selective Electrode	NO3-BTA	$179	✔	✔	✔	✔	✔	✔	128
Light Sensor	LS-BTA	$55	✔	✔	✔	✔	✔	✔	129
Magnetic Field Sensor	MG-BTA	$58	✔	✔	✔	✔	✔	✔	129
Mass (Ohaus Balances)					*Computer USB*				50
Melt Station	MLT-BTA	$449	✔	✔	✔	✔	✔	✔	129
Microphone	MCA-BTA	$39	✔	✔	✔			✔	130
NEW Mini GC Plus	GC2-MINI	$1,799	✔		*Computer USB*				130

SENSOR	CODE	PRICE	LABQUEST/ LABQUEST 2	LABQUEST MINI	LABPRO	GO! LINK	EASYLINK	TI LAB CRADLE	PAGE
Motion Detectors									
Motion Detector	MD-BTD	$79	✔	✔	✔			✔	130
Go!Motion	GO-MOT	$109	✔		*Computer USB*				130
CBR 2 *(calculators only)*	CBR2	$99					*Calculator USB and I/O*		114
O_2 Gas Sensor	O2-BTA	$188	✔	✔	✔	✔	✔	✔	131
ORP Sensor	ORP-BTA	$79	✔	✔	✔	✔	✔	✔	131
pH Sensor	PH-BTA	$79	✔	✔	✔	✔	✔	✔	131
pH Sensor, Tris-Compatible Flat	FPH-BTA	$99	✔	✔	✔	✔	✔	✔	131
Photogate	VPG-BTD	$45	✔	✔	✔			✔	132
Polarimeter (Chemical)	CHEM-POL	$499	✔	✔	✔			✔	132
Power Amplifier	PAMP	$199	✔		✔*				133
Projectile Launcher	VPL	$299	✔	✔	✔			✔	93
NEW Pyranometer	PYR-BTA	$199	✔	✔	✔	✔	✔	✔	133
Radiation Monitors									
NEW Vernier Radiation Monitor	VRM-BTA	$169	✔	✔	✔			✔	133
Radiation Monitor (Digital)	DRM-BTD	$299	✔	✔	✔			✔	133
Relative Humidity Sensor	RH-BTA	$69	✔	✔	✔	✔	✔	✔	134
Respiration Monitor Belt *(requires GPS-BTA)*	RMB	$63	✔	✔	✔	✔	✔	✔	134
Rotary Motion Sensor	RMV-BTD	$169	✔	✔	✔			✔	134
Salinity Sensor	SAL-BTA	$92	✔	✔	✔	✔	✔	✔	135
Soil Moisture Sensor	SMS-BTA	$95	✔	✔	✔	✔	✔	✔	135
Sound Level Meter	SLM-BTA	$165	✔	✔	✔	✔	✔	✔	135
Spectrometers									
SpectroVis Plus Spectrophotometer	SVIS-PL	$459	✔		*Computer USB*				136
Ocean Optics Spectrometers			✔		*Computer USB*				48
Spirometer	SPR-BTA	$199	✔	✔	✔	✔	✔	✔	136
Temperature Probes									
EasyTemp *(calculators only)*	EZ-TMP	$38					*Calculator USB*		114
Extra-Long Temperature Probe	TPL-BTA	$79	✔	✔	✔	✔	✔	✔	137
Go!Temp	GO-TEMP	$39	✔		*Computer USB*				17
Infrared Thermometer	IRT-BTA	$169	✔	✔	✔	✔	✔	✔	137
Stainless Steel Temperature Probe	TMP-BTA	$29	✔	✔	✔	✔	✔	✔	137
Surface Temperature Sensor	STS-BTA	$23	✔	✔	✔	✔	✔	✔	137
Thermocouple	TCA-BTA	$69	✔	✔	✔	✔	✔	✔	138
Wide-Range Temperature Probe	WRT-BTA	$79	✔	✔	✔	✔	✔	✔	137
Turbidity Sensor	TRB-BTA	$112	✔	✔	✔	✔	✔	✔	138
UVA Sensor	UVA-BTA	$106	✔	✔	✔	✔	✔	✔	138
UVB Sensor	UVB-BTA	$107	✔	✔	✔	✔	✔	✔	138
Voltage Probes									
Differential Voltage Probe	DVP-BTA	$39	✔	✔	✔	✔	✔	✔	139
Voltage Probe	VP-BTA	$12	✔	✔	✔	✔	✔	✔	139
30-Volt Voltage Probe	30V-BTA	$49	✔	✔	✔	✔	✔	✔	139
Watts Up Pro	WU-PRO	$145	✔		*Computer USB*				139
Wireless Dynamics Sensor System	WDSS	$249	✔		*Wireless computer use*				140

† With computer only * Not supported with calculators • Use with the original LabQuest. GPS is built into LabQuest 2. ° For calculators, TI-Nspire only

NEW Sensors for 2013

Ethanol Sensor
PAGE 125

Goniometer
PAGE 127

Vernier Optical DO Probe
PAGE 124
Available Spring 2013

Pyranometer
PAGE 133

Vernier Radiation Monitor
PAGE 133

Accelerometers

3-Axis, Low-g and 25-g

We have three accelerometers designed for different uses. These small devices can be mounted on objects to study motion. All are individually calibrated.

3-Axis Accelerometer

ORDER CODE **3D-BTA, $99**

Use this for studying the complex motion of an amusement park ride, a bungee jump, or simply a toss in the air.

RANGE: -50 to +50 m/s^2 **TYPICAL ACCURACY:** ±0.1 m/s^2

Low-g Accelerometer, ORDER CODE LGA-BTA, $89

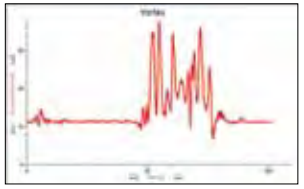
This is the best choice for most experiments. Use it for studying the one-dimensional motion of a car (real and toy), elevator, pendulum bob, or amusement park ride.

RANGE: -50 to +50 m/s^2 **TYPICAL ACCURACY:** ±0.1 m/s^2

25-g Accelerometer, ORDER CODE ACC-BTA, $92

This is great for studying one-dimensional collisions or any motion with larger accelerations.

RANGE: -250 to +250 m/s^2 **TYPICAL ACCURACY:** ±1 m/s^2



Accelerations during the Vortex amusement park ride

See also WDSS on page 140.

GREAT WAYS TO USE THESE SENSORS!

PHYSICS
- Bungee jump accelerations
- Newton's second law
- Centripetal acceleration on a turntable
- Acceleration on a merry-go-round

HUMAN PHYSIOLOGY
- Neuromuscular reflexes

INNOVATIVE USES
- Accelerations on the half pipe
- Accelerations in snowboarding

Anemometer

$89 ORDER CODE **ANM-BTA**

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mount on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

RANGE: 0.5 m/s ~ 30 m/s

RESOLUTION:
10-bit resolution (using CBL 2): 4.8 x 10^{-2} m/s
12-bit resolution (using LabQuest, LabQuest Mini, LabPro, Go!Link, EasyLink): 1.2 x 10^{-2} m/s
13-bit resolution (using SensorDAQ): 6.0 x 10^{-3} m/s

Using the Anemometer to measure wind speed

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL SCIENCE
- Measure the wind speed of air
- Measure the effects of design on wind turbine's output
- Measure the effects on cooling rate
- Measure wind speed in wind tunnels
- Use with a compass to determine wind direction
- Investigate wind speed over land and water

Barometer

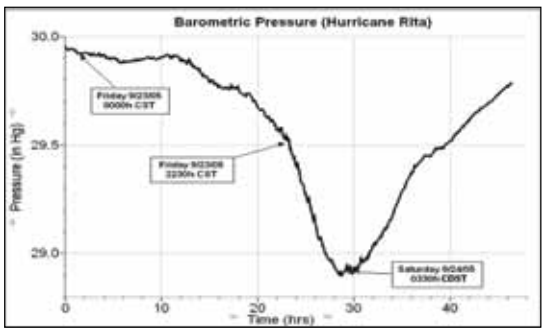
$71 ORDER CODE **BAR-BTA**

Our Barometer can be used for weather studies or for lab experiments involving pressures close to normal air pressure.

RANGE: 25.0 to 31.5 inHg 81 to 106 kPa
0.80 to 1.05 atm 600 to 800 mmHg

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.003 inHg

10-bit (CBL, CBL 2, NXT Adapter): 0.01 inHg



Atmospheric pressure data collected during Hurricane Rita in 2005

GREAT WAYS TO USE THIS SENSOR!

EARTH SCIENCE
- Barometric pressure
- Local weather study

INNOVATIVE USES
- Study the barometric pressure of storms
- Use it as an altimeter
- Study Bernoulli's principle

Blood Pressure Sensor

$105 ORDER CODE **BPS-BTA**

The Blood Pressure Sensor is a noninvasive sensor designed to measure human blood pressure.

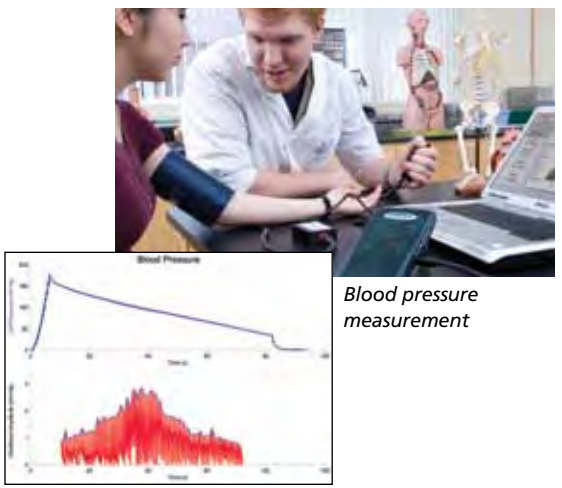
- Measures systolic and diastolic blood pressure utilizing the oscillometric technique.
- Includes a standard adult-size adjustable cuff (27 cm to 39 cm), pump bulb, and pressure transducer.

Additional cuff sizes are available for best results on small or large arms. Each includes cuff, pump, and valve.

Small Cuff, 18 cm to 27 cm, ORDER CODE **CUFF-SM, $32**
Large Cuff, 35 cm to 51 cm, ORDER CODE **CUFF-LG, $35**

PRESSURE RANGE: 20 mmHg to 250 mmHg

TYPICAL ACCURACY: ±3 mmHg



Blood pressure measurement

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY

- Blood pressure as a vital sign
- Effect of exercise on blood pressure
- Diurnal blood pressure variation
- Heart rate and blood pressure as vital signs
- Heart rate, blood pressure, and exercise

Charge Sensor

$75 ORDER CODE **CRG-BTA**

Use the Charge Sensor as an electronic electroscope to obtain quantitative measurements when studying charging by induction, friction, or contact.

- A 0.01 µF input capacitor makes it possible for this extremely high impedance voltage sensor to be used in many electrostatic experiments.
- Range switch allows you to adjust sensitivity.
- Zero switch discharges the input capacitor between runs.

RANGES: ±0.5 V (+/- 5 nC)
±2 V (+/- 20 nC)
±10 V (+/- 100 nC)

Typical bias current: 0.005 pA
Input capacitance: 0.01 µF

Electrostatics Kit

ORDER CODE **ESK-CRG, $109**

The Electrostatics Kit is an accessory for the Charge Sensor. The kit includes a Faraday pail and cage, grounding plane, grounding wires and wrist strap, charge producers and proof plane, wool, vinyl, nylon rod, PVC rod, and a cotton cloth. See page 87.

High Voltage Electrostatics Kit

ORDER CODE **HVEK-CRG, $249**

The Electrostatics Kit is an accessory for the Charge Sensor. The kit includes an electrostatics voltage source (output 750, 1500, 3000, 6000 V DC) and two conducting spheres. Extremely low output current makes this device safe for classroom use. See page 87.

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES

- Use as electronic electroscope
- Charging by induction, by friction, and by contact
- Measure charge polarity

More innovative uses from teachers at **www.vernier.com/innovate**

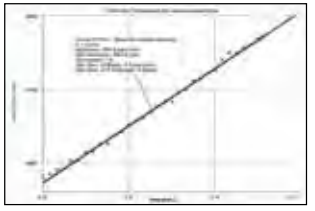
CO_2 Gas Sensor

$249 ORDER CODE **CO2-BTA**

The CO_2 Gas Sensor measures gaseous carbon dioxide in two ranges—0 to 10,000 ppm and 0 to 100,000 ppm.

- Explore human respiratory changes in CO_2 levels based on exercise with the high range.
- The lower range offers more sensitivity and a wider interval for cellular respiration and photosynthetic metabolism studies.

RANGE: Low 0–10,000 ppm
High 0–100,000 ppm



Measuring CO_2 levels of germinating peas

BioChambers

BioChambers provide a way for both CO_2 Gas and O_2 Gas Sensors, or one of these along with the Ethanol Sensor, to be used at the same time in a closed system.

BioChamber 2000, 2000 mL
ORDER CODE **BC-2000, $19**

BioChamber 250, 250 mL
ORDER CODE **BC-250, $6**

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY

- Cell respiration in peas
- Respiration of sugars by yeast
- Effect of temperature on cold-blooded organisms
- Photosynthesis and respiration
- Levels of CO_2 in human respiration
- Measure CO_2 along with O_2 in respiration and photosynthesis

ENVIRONMENTAL SCIENCE

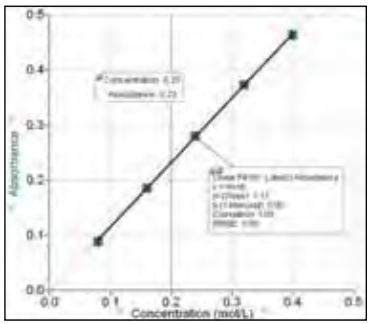
- Investigating indoor CO_2 concentrations

Colorimeter

$115 ORDER CODE COL-BTA

This 4-wavelength Colorimeter features one-button automatic calibration. Fifteen 3.5 mL cuvettes are included. A package of 100 replacement cuvettes (with 20 lids) is available (ORDER CODE CUV, $15).

WAVELENGTHS: 430 nm 470 nm 565 nm 635 nm



Beer's law experiment

Cuvette Rack

ORDER CODE **CUV-RACK, $9**

No more spills! Holds ten standard cuvettes.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Beer's law: determining the concentration of unknown substances
- Kinetics: rate and order of a chemical reaction
- Rate determination and activation energy
- Chemical equilibrium: Finding a constant, K_c
- Rate law determination of the crystal violet reaction

BIOLOGY
- Photosynthesis
- The effect of alcohol on biological membranes
- Population dynamics

WATER QUALITY
- Ortho- and total-phosphates concentration

FORENSICS
- Identifying an unknown ink by its light absorbance characteristics

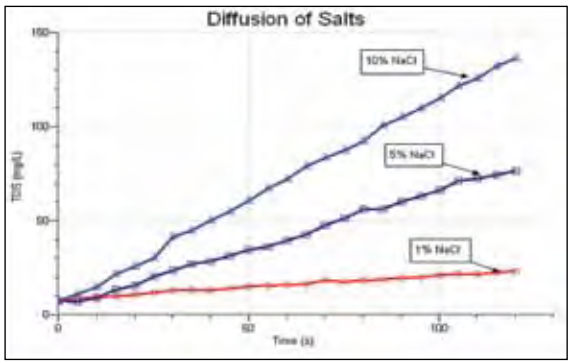
Conductivity Probe

$95 ORDER CODE CON-BTA

This probe measures the electrical conductivity of water. It is an important part of chemistry, biology, and water quality studies.

AUTOMATIC TEMPERATURE COMPENSATION: 5°C–35°C

LOW RANGE:	MEDIUM RANGE:	HIGH RANGE:
0–200 µS/cm	0–2000 µS/cm	0–20000 µS/cm
(0–100 mg/L TDS)	(0–1000 mg/L TDS)	(0–10000 mg/L TDS)



Diffusion through membranes

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Diffusion of ions through membranes
- Monitor changes in ion levels in aquatic systems
- Limitations of cell size: surface area to volume

MIDDLE SCHOOL
- Water hardness study
- Diffusion: how fast?

CHEMISTRY
- Investigate ionic and molecular compounds, strong and weak acids
- Conductimetric titrations
- Investigate ionic concentrations and conductivity levels

WATER QUALITY
- Total dissolved solids

PHYSICAL SCIENCE
- Acid strengths

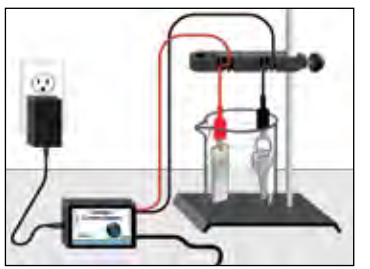
Constant Current System

$59 ORDER CODE CCS-BTA

The Constant Current System is a DC power source capable of delivering up to 0.6 A with a built-in current probe designed for use in electrochemistry experiments. The user can set the current by turning the dial with the system automatically adjusting the voltage.

Note: The Constant Current System works only with its own built-in power supply. It cannot be used to measure the current of a circuit using a different power supply.

RANGE: 0 to 0.6 A
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, TI-Nspire Cradle): 0.18 mA



Electroplating a key

IMPROVED Electrode Support

ORDER CODE **ESUP, $10**

Our Electrode Support is a perfect holder for many sensors. With our improved design, you can suspend the wire leads for your electroplating setup.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Electroplating
- Determining Avogadro's Number

Current Probes

Current Probe

$39 ORDER CODE DCP-BTA

Use the Current Probe to measure currents in low-voltage AC and DC circuits. With a range of ±0.6 A, this probe is ideal for use in most battery and bulb circuits. Use multiple sensors to explore series and parallel circuits. It can also be used in electrochemistry experiments.

RANGE: -0.6 to +0.6 A **SENSE RESISTOR:** 0.1 Ω
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.3 mA
10-bit (CBL, CBL 2, NXT Adapter): 1.25 mA

Studying Ohm's law using the Current Probe, Differential Voltage Probe, and the Vernier Circuit Board

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Electroplating
- Determining Avogadro's number

ENVIRONMENTAL SCIENCE
- Solar energy: photovoltaic cells
- Wind energy

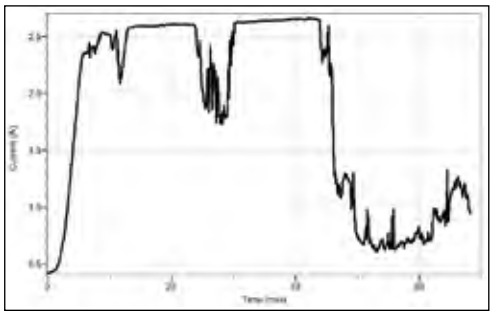
PHYSICS
- Ohm's law
- Series and parallel circuits
- Electrical energy

High Current Sensor

$79 ORDER CODE HCS-BTA

The High Current Sensor is used to measure current in the range of ±10 A. The sensor uses a Hall Effect chip, so that it does not add a resistive element to your circuit. A metal shield over the Hall Effect chip reduces the influence of external magnets. A replaceable fuse protects the equipment and circuit.

RANGE SETTINGS: 10A; maximum voltage input 40 V
RESOLUTION:
13-bit resolution (SensorDaq): 2.4 mA
12-bit resolution (LabQuest, LabQuest Mini, LabPro, Go!Link): 4.9 mA



Current produced by a large solar panel vs. time

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Record currents from a solar panel
- Record currents from popular hand-held generators
- Record current in do-it-yourself projects with larger current, such as wind generators

Digital Control Unit

$61 ORDER CODE DCU-BTD

The Digital Control Unit (DCU) makes it easy to use the digital ports on SensorDAQ, LabQuest LabQuest 2, LabQuest Mini, LabPro, or CBL 2 for exciting, do-it-yourself projects.

- Write simple programs to control motors, lamps, LEDs, buzzers, and other DC devices.
- Develop elaborate projects to control robots or automated scientific apparatuses in combination with other sensors.

Provides up to 600 mA of current.

The Digital Control Unit being used to make an automated tea brewer

Includes:

- A manual with project ideas
- Explanations of how to write DCU programs in LabVIEW using SensorDAQ
- A cable for connecting electrical devices that you build
- Explanation of DCU programming using our LabPro interface and LabVIEW™, or TI graphing calculator programs
- Wiring diagrams

DCU Power Supply, ORDER CODE **IPS, $12**

Note: The Digital Control Unit does not work with LabQuest App but will work with LabQuest and Logger *Pro* 3.7 and newer.

GREAT WAYS TO USE THIS SENSOR!

ENGINEERING
- Turn on motors or buzzers
- Make an alarm system
- Make a robot
- Create temperature-controlled environments
- Moving displays
- Flash lamps on LEDs

Dissolved Oxygen Probes

NEW Vernier Optical DO Probe

Available Spring 2013

$379 ORDER CODE ODO-BTA

The Vernier Optical DO Probe makes it easy to measure the dissolved oxygen concentration in water. Perfect for the field or for the laboratory, this plug-and-play probe requires no calibration, no filling solution, no warm-up time, and no stirring.

Dissolved Oxygen Probe

$209 ORDER CODE DO-BTA

Use the original Dissolved Oxygen Probe to determine the concentration of oxygen in aqueous solutions.

- Built-in temperature compensation and a fast response time.
- Includes zero-oxygen solution, two caps fitted with membranes, a 100% calibration bottle, and electrode filling solution.

AUTOMATIC TEMPERATURE COMPENSATION: 5°C to 35°C

RANGE: 0 to 14 mg/L

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.007 mg/L
10-bit (CBL, CBL 2, NXT Adapter): 0.028 mg/L

See page 35 to help determine which DO probe is right for you.

GREAT WAYS TO USE THESE SENSORS!

BIOLOGY
- Interdependence of plants and animals
- Aerobic respiration
- Dissolved oxygen *vs.* time
- Watershed testing
- Physical profile of a lake
- Primary productivity

WATER QUALITY
- Dissolved oxygen concentration
- Biochemical oxygen demand (BOD)

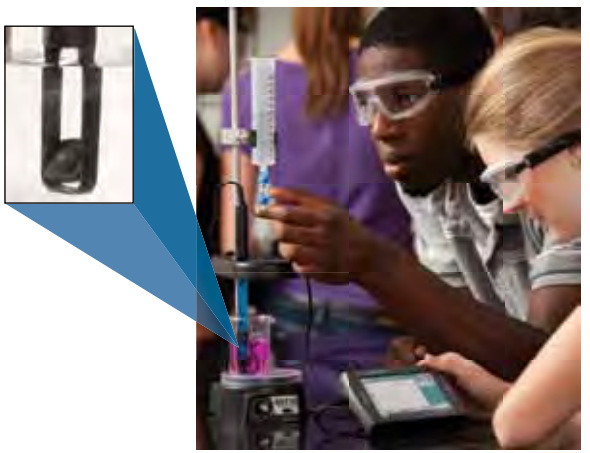
ENVIRONMENTAL SCIENCE
- Long term water monitoring
- Investigating dissolved oxygen

Drop Counter

$99 ORDER CODE VDC-BTD

Use the Drop Counter with our pH Sensor, Conductivity Probe, or ORP Sensor to easily perform conductimetric or potentiometric titrations.

- Precisely records the number of drops of titrant added during a titration, which is automatically converted into volume.
- Includes a cable, Microstirrer (shown below), and reagent reservoir.



A Microstirrer is included with the Drop Counter. Additional Microstirrers are available (ORDER CODE MSTIR, $9).

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Acid-based titration
- Standardizing a solution of sodium hydroxide
- Oxidation-reduction titration
- Investigating indicators
- Conductimetric titration and gravimetric determination of a precipitate
- Potentiometric titration of hydrogen peroxide

Dual-Range Force Sensor

$109 ORDER CODE DFS-BTA

Our Dual-Range Force Sensor can be easily mounted on a ring stand or dynamics cart or used as a replacement for a hand-held spring scale. It has two ranges: ±10 N and ±50 N and resolution of 0.01 N and 0.05 N, respectively.

Dual-Range Force Sensor Accessories

Bumper and Launcher Kit, ORDER CODE **BLK, $89**
See page 89 for more information.

Air Track Adapter, ORDER CODE **ATA-DFS, $55**
Allows the Dual-Range Force Sensor to be mounted on the end of an air track for collision studies. Compatible with most air tracks. Includes two magnetic bumpers.

Force Table Adapter, ORDER CODE **FTA-DFS, $29**
Use your Dual-Range Force Sensor with your force table for resolution of vectors experiments. Includes mounting clamp.

Mass For Dynamics Cart, ORDER CODE **MASS, $12**
This 500 g steel block is a great accessory for Newton's second law labs. It attaches to a dynamics cart and leaves room for both a Dual-Range Force Sensor and an Accelerometer.

GREAT WAYS TO USE THESE SENSORS!

PHYSICS
- Newton's second law
- Newton's third law
- Static and kinetic friction
- Impulse and momentum

PHYSICAL SCIENCE
- Frictional forces
- Pulleys

MIDDLE SCHOOL
- Friction
- First-class levers

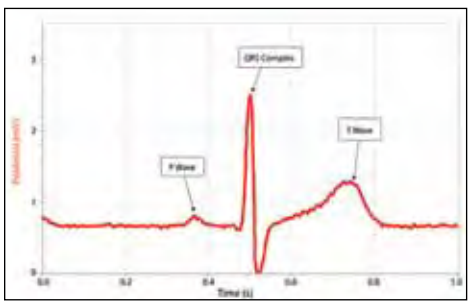
EKG Sensor

$147 ORDER CODE EKG-BTA

Use the EKG Sensor to measure electrical signals produced during muscle contractions.

- Make standard 3-lead EKG tracings to record electrical activity in the heart.
- Collect surface EMG recordings to study contractions in muscles in your arm, leg, or jaw.

Each sensor includes a package of 100 disposable electrodes. Additional packages of 100 electrodes are available (ORDER CODE ELEC, $12).



EKG graph demonstrating the contraction and repolarization of the heart's chambers

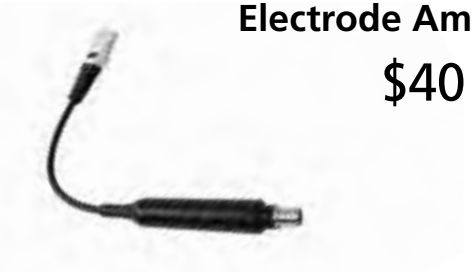
GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Analyzing the heart with EKG
- Introduction to EMG
- Neuromuscular reflexes
- Muscle function analysis
- EMG and muscle fatigue

BIOLOGY
- Monitoring EKG

INNOVATIVE USE
- Monitor the heart rate of crawfish

Electrode Amplifier



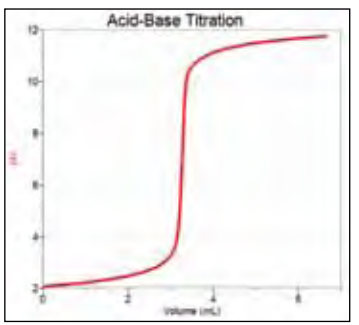
$40 ORDER CODE EA-BTA

This sensor is a mV/pH/ORP amplifier that accepts an electrode with a standard BNC connector. It amplifies a –450 mV to +1100 mV signal to a 0 to 5 V range.

It can be used with any of the following:

- Vernier BNC pH Electrode (ORDER CODE 7120B, $41)
- Most third-party pH electrodes (with BNC connectors)
- Other high output impedance electrodes
- Most third-party ORP electrodes (with BNC connectors)

See page 131 for our pH Sensor options.



Acid-base titration curve

BUY WITH CONFIDENCE

Our 5-year warranty on most Vernier products gives you a superior level of buying confidence. In fact, in Vernier's 32 years of business, we have rarely charged a customer for a repair, no matter how old the equipment!

NEW Ethanol Sensor

$109 ORDER CODE ETH-BTA

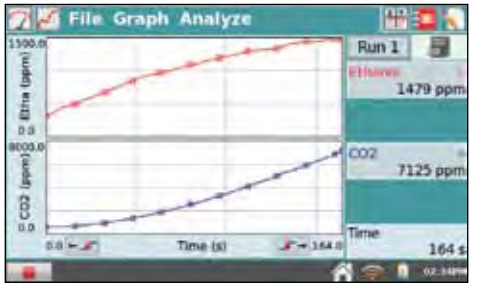
The Ethanol Sensor measures the concentration of ethanol in the air above an aqueous sample.

This sensor has a wide variety of applications.

- Measure the rate of ethanol production by yeast.
- Determine if specific organisms can utilize ethanol fermentation as a metabolic pathway.
- Determine which sugars yeast are able to ferment.
- Investigate variables that increase or decrease the rate of ethanol production.
- Investigate variables that increase or decrease the rate of ethanol production.

RANGE: 0% to 3%

RESOLUTION:
12-bit (LabQuest 2, LabQuest, LabQuest Mini, LabPro, TI-Nspire Lab Cradle): 0.02% from 2-3%, 0.01% from 1-2%, 0.001% from 0-1%
10-bit (CBL 2): 0.04% from 2-3%, 0.02% from 1-2%, 0.002% from 0-1%



Measuring CO_2 gas and ethanol production during fermentation

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Determine which sugars yeast can metabolize
- Observe ethanol and CO_2 production during fermentation

CHEMISTRY
- Measure the concentration of ethanol in a sample

Flow Rate Sensor

$129 ORDER CODE FLO-BTA

Use the Flow Rate Sensor to easily measure stream velocity for environmental or Earth science studies. Flow rate data can be used to calculate the discharge value for the stream or study the sediment transport of the stream.

- Separates into four sections for easy transport and convenient storage.
- Equipped with a 5 m cable, so your data-collection equipment can stay on shore.
- Includes 3 riser rods, which enable the impeller to be placed at fixed depths.

RANGE: 0 to 4 m/s

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.0012 m/s
10-bit (CBL, CBL 2, NXT Adapter): 0.005 m/s

Collecting flow rate data with a LabQuest

GREAT WAYS TO USE THIS SENSOR!

WATER QUALITY
- Measure stream flow rates
- Investigate sediment transport
- Determine stream discharge values

Force Plate

$225* ORDER CODE FP-BTA

The Force Plate is a large force sensor—tough enough to jump on. About the size and shape of a bathroom scale, the Force Plate has two ranges, one reading up to 3500 N and the other to 800 N. Two handles are included for pushing or pulling. Additional pairs of handles are available (ORDER CODE FP-HAN, $15).

RANGE: -850 to 3500 N and -200 to 850 N

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 1.2 N or 0.3 N
10-bit (CBL, CBL 2, NXT Adapter): 4.8 N or 1.2 N

Studying Newton's third law

*Additional shipping charges may apply

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Study the dynamics of jumping and walking
- Study how the normal force on your feet changes during an elevator ride
- Try pushing a car across the parking lot
- Use two Force Plates to study Newton's third law

Gas Pressure Sensor

$83 ORDER CODE GPS-BTA

The Gas Pressure Sensor has sufficient resolution and range to work for many subject areas:

Chemistry
- Wide enough range for Boyle's law experiments.
- Sufficient resolution for vapor-pressure or pressure-temperature experiments.

Biology
- Use the included airtight tubing clamps for transpiration experiments.
- Perform respiration experiments in small containers using included fittings.

Includes the Pressure Sensor Accessories Kit (shown above). For replacement parts, see page 141.

RANGE: 0 to 210 kPa (0 to 2.1 atm or 0 to 1600 mm Hg)

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.05 kPa (0.0005 atm or 0.40 mm Hg)
10-bit (CBL or CBL 2, NXT Adapter): 0.2 kPa (0.002 atm or 1.6 mm Hg)

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Transpiration
- Enzyme action: testing catalase activity
- Sugar fermentation

MATH
- Under pressure: the inverse relationship between pressure and volume

PHYSICAL SCIENCE
- Gas pressure and volume
- Gas temperature and pressure

CHEMISTRY
- Boyle's law
- Pressure-temperature
- Volume-temperature relationship in gases
- Vapor pressure of liquids
- Ideal gas law investigation

MIDDLE SCHOOL
- Get a grip!
- Fun with pressure

NEW Goniometer

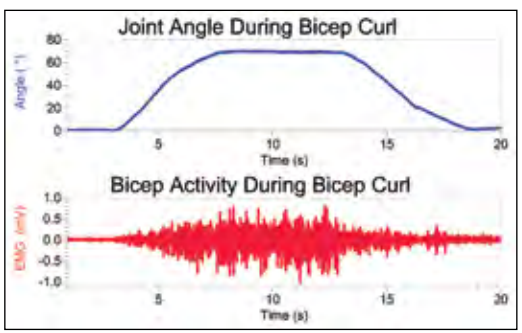
$159 ORDER CODE GNM-BTA

The Goniometer can be used to measure the dynamic motion of a limb during different types of physical activity.

- A set of elastic straps are used to secure the sensor to the subject.
- The lightweight and flexible joint arms allow the limb to move naturally.
- Use it with an EKG sensor to measure muscle activity during limb motion.
- The sensor can also be detached from the base plate and flexible arms so it can be used in a variety of STEM and engineering activities.

RANGE: 0 to 340° (±170°)

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.05°
10-bit (CBL, CBL 2, NXT Adapter): 0.12°



Using a Goniometer and EKG sensor to measure joint angle and muscle activity

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Monitor joint angle
- Determine range of motion
- Muscle function analysis

ENGINEERING
- Propeller-powered pendulum

Vernier GPS Sensor

$64 ORDER CODE VGPS

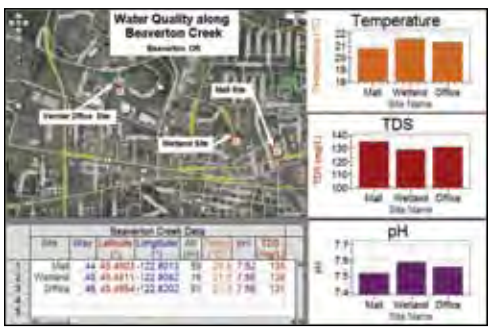
The Vernier Global Positioning System (GPS) Sensor collects latitude, longitude, and altitude, right on your original LabQuest* or computer.

- See a real-time graphs of latitude *vs*. longitude, or export the data to various mapping programs, including Google Maps or ArcGIS.
- Connects directly to the USB port on a computer or original LabQuest*

Use GPS to enhance data collection:

- Performing water quality tests at multiple sites? Record your location as you make measurements, and then map the data using Logger *Pro*.
- Studying acceleration in a car or train? Collect location information along with acceleration data and display a color-coded map.

**Note: Not needed for LabQuest 2. LabQuest 2 has a built-in GPS sensor.*



Logger Pro combines GPS data and water quality sensor data.

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL SCIENCE
- Map discrete points when monitoring environmental conditions

INNOVATIVE USE
- Map the acceleration and position of a moving object.

Hand Dynamometer

$99 ORDER CODE HD-BTA

Our strain-gage based isometric dynamometer can be used to measure grip strength or finger-pinch strength. The Hand Dynamometer can be used alone or in combination with EMG recordings for detailed studies of muscular activity.

FORCE RANGE: 0–600 N **TYPICAL ACCURACY:** ±0.6 N

Measuring grip strength

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Grip strength comparison
- Grip strength and muscle fatigue
- EMG and muscle strength
- Measure pinch strength in fingers

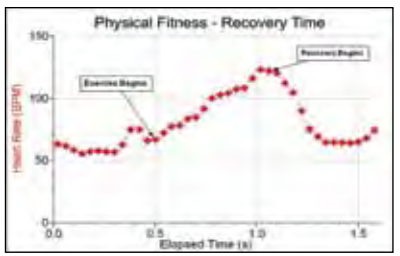
Hand-Grip Heart Rate Monitor

$119 ORDER CODE **HGH-BTA**

The Hand-Grip Heart Rate Monitor is ideal for continuously monitoring heart rate before, during, and after exercise or while a person is stationary.

- Hand grips do not require electrodes or clips.
- Easily shared between students.

Hand grips detect electrical pulses generated by the heart, wirelessly transmit a signal to the receiver module, and the individual's pulse or heart rate is calculated.



Recovery rate determined by monitoring heart rate

Chest Belt Transmitter

ORDER CODE **CBT, $48**

You can use our Chest Belt Transmitter in conjunction with the Hand-Grip Heart Rate Monitor's receiver for a hands-free option of measuring heart rate.

GREAT WAYS TO USE THESE SENSORS!

HUMAN PHYSIOLOGY
- Heart rate as a vital sign
- Heart rate and exercise
- Heart rate and blood pressure as vital signs
- Effect of coughing on heart rate
- Response to baroreceptor feedback

MIDDLE SCHOOL
- Heart rate and body position
- Heart rate and exercise

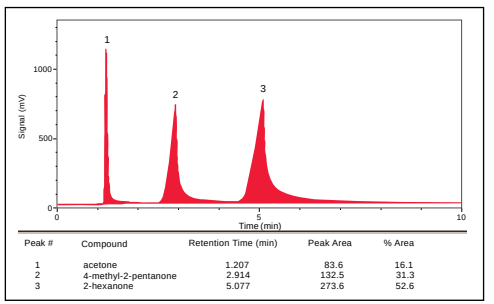
BIOLOGY
- Heart rate and physical fitness
- Ventilation and heart rate

Instrumentation Amplifier

$59 ORDER CODE **INA-BTA**

The Instrumentation Amplifier is used to amplify small signals so they can be measured with a Vernier interface. The input bandwidth of 10 kHz allows the capture of higher frequency signals. The Instrumentation Amplifier monitors voltages from 20 mV to 1 V full scale (DC or AC). It has six switch settings to allow you to select the best gain. It is often used to amplify the chart recorder or analog output of any instrument, such as a third-party gas chromatograph. Or, you can use the Instrumentation Amplifier to measure small induced currents in coils.

RANGE SETTINGS: 0–20 mV, 0–200 mV, 0–1 V, ±20 mV, ±200 mV, ±1 V



Peak #	Compound	Retention Time (min)	Peak Area	% Area
1	acetone	1.207	83.6	16.1
2	4-methyl-2-pentanone	2.914	132.5	31.3
3	2-hexanone	5.077	273.6	52.6

Data collected using an Instrumentation Amplifier attached to a third-party gas chromatograph

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Investigating resistivity
- Use to amplify signals from third-party laboratory instruments
- Use to replace a strip-chart recorder for recording instrument data

Ion-Selective Electrodes

$179 ORDER CODE **SEE BELOW**

Our Ion-Selective Electrodes (ISEs) are for monitoring four environmentally important ions: Nitrate (NO_3^-), Chloride (Cl^-), Calcium (Ca^{2+}), and Ammonium (NH_4^+).

- The Nitrate, Calcium, and Ammonium ISEs are combination-style, non-refillable, and gel-filled. The Chloride ISE is a solid state device; it does not have a replacement module.
- Vernier ISE membranes, like all other PVC ISE membranes, have a limited life expectancy. However, the replaceable module of Vernier ISEs allows you to simply discard the used membrane module, and replace it with a new one. To purchase replacement modules, see page 141.
- Included with each ISE are two calibration standards and a short-term soaking bottle. To purchase additional standards, see page 141.

AMMONIUM ISE:
RANGE: 0.1 to 18,000 mg/L or ppm

CALCIUM ISE:
RANGE: 0.2 to 40,000 mg/L or ppm

CHLORIDE ISE:
RANGE: 1.8 to 35,000 mg/L or ppm

NITRATE ISE:
RANGE: 0.1 to 14,000 mg/L or ppm

Nitrate ISE
ORDER CODE **NO3-BTA, $179**

Calcium ISE
ORDER CODE **CA-BTA, $179**

Chloride ISE
ORDER CODE **CL-BTA, $179**

Ammonium ISE
ORDER CODE **NH4-BTA, $179**

Ion-Selective Electrodes require good chemical technique and careful calibration to obtain accurate results. They are not recommended for middle school or elementary school students. ISE modules are covered by a one-year warranty.

GREAT WAYS TO USE THESE SENSORS!

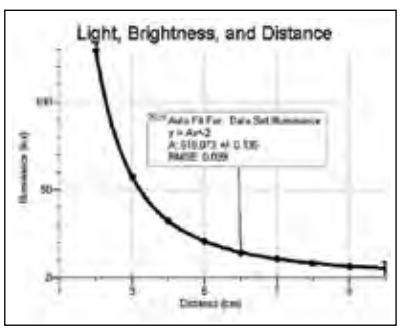
WATER QUALITY
- Calcium and water hardness
- Chloride and salinity
- Monitor ammonium concentration
- Monitor nitrate concentration

Light Sensor

$55 ORDER CODE LS-BTA

Our Light Sensor approximates the human eye in spectral response and can be used over three different illumination ranges that you select with a switch. Use it for inverse-square law experiments or for studying polarizers, reflectivity, or solar energy.

LOW RANGE:	MEDIUM RANGE:	HIGH RANGE:
0 to 600 lux	0 to 6000 lux	0 to 150,000 lux



Inverse square law of light

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Polarization of light
- Inverse square law

PHYSICAL SCIENCE
- Reflectivity of light
- Polaroid filters
- How bright is the light?

MATH
- Inverse square relationship
- Periodic phenomena

MIDDLE SCHOOL
- Reflectivity of light
- Schoolyard study

EARTH SCIENCE
- Reflection and absorption of light
- Photovoltaic cells
- Measuring particulates

Magnetic Field Sensor

$58 ORDER CODE MG-BTA

Use the Magnetic Field Sensor to study the field around permanent magnets, coils, and electrical devices.
- Sensitive enough to measure the Earth's magnetic field.
- Rotating tip allows you to measure both transverse and longitudinal magnetic fields.

LOW SENSITIVITY:	HIGH SENSITIVITY:
RANGE: -6.4 to +6.4 millitesla (mT)	**RANGE:** -0.32 to +0.32 mT

Measuring the magnetic field in a coil

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- The magnetic field in a coil
- The magnetic field in a slinky
- The magnetic field of a permanent magnet

PHYSICAL SCIENCE
- Electromagnets

MIDDLE SCHOOL
- Mapping a magnetic field

EARTH SCIENCE
- Exploring magnetism
- Where is north?
- Searching for iron ore

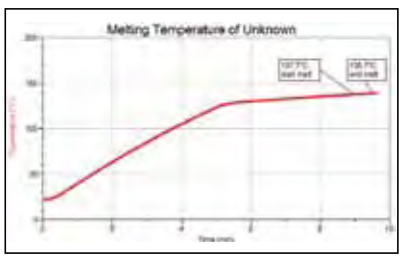
Melt Station

$449 ORDER CODE MLT-BTA

Our Melt Station is used to measure the melting temperature of solid substances.
- Accurate results using built-in RTD over a range of 20°C to 260°C
- High-quality 6X viewing lens for clear observation of the samples
- Innovative, adjustable tilt allows for optimal viewing angle
- Cooling fan reduces time between tests

Each Melt Station comes with 100 standard capillary tubes. Additional packages of 100 are available, (ORDER CODE MLT-TUBE, $15).

RANGE: 20°C to 260°C
ACCURACY: ± 0.2°C up to 200°C, ± 0.4°C above 200°C
RESOLUTION: 0.10°C
CALIBRATION: factory calibrated
POWER: separate AC power supply (included)
DIMENSIONS: 9 cm × 11 cm × 26 cm
FOOTPRINT: 13 cm × 15 cm



Sample graph of temperature vs. time marking the melting temperature

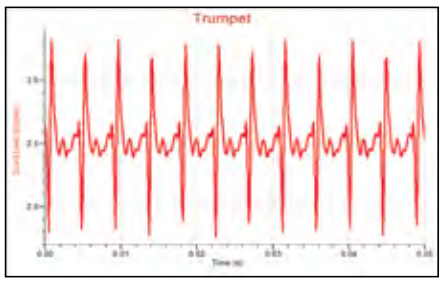
GREAT WAYS TO USE THIS SENSOR!

ORGANIC CHEMISTRY
- Determining Melting Temperature
- Recrystallization of Benzoic Acid and Aspirin
- Identifying Unknown Analgesic
- Separation of Organic Compounds
- Synthesis of Dibenzalacetone by Aldol Condensation

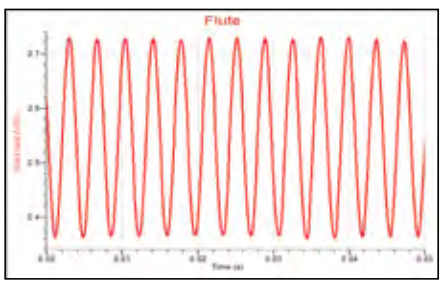
Microphone

$39 ORDER CODE MCA-BTA

Use our Microphone to display and study the waveforms of sounds from voices and musical instruments. It is also appropriate for speed of sound experiments.



Waveform of a trumpet



Waveform of a flute

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Sound waves and beats
- Tones, vowels and telephones
- Investigate musical scales
- Speed of sound

MATH
- Sound waveform modeling

FORENSICS
- Identify the musical notes that make up the combination to a safe

IMPROVED Mini GC Plus

$1,799 ORDER CODE GC2-MINI

Use the Vernier Mini GC Plus gas chromatograph to separate and identify even more compounds than the original Mini GC, while still using air as the carrier gas. Perform analysis and peak integration using LabQuest as a standalone device or with Logger *Pro* software on a computer. The Mini GC Plus is covered by a two-year warranty (syringe, column, sensor, and septa excluded). More details on page 46.

FAMILIES OF COMPOUNDS THAT CAN BE USED IN THE MINI GC PLUS:
Alcohols, aldehydes, aromatic hydrocarbons, carboxylic acids, chlorinated hydrocarbons, esters, ethers, ketones, nitriles and more.

MEMS DETECTOR:
The unique Seacoast Science MEMS Chemi-Capacitive Detector is state-of-the-art technology that allows air to be used as the carrier gas.

COLUMN:
High-quality Restek MXT-1 stainless steel capillary column (11 meter)

TEMPERATURE REGULATION:
Software-controlled temperature regulation from 30–160°C

COLUMN TEMPERATURE RAMP:
- Maximum of 10°C/minute
- Short warm-up time: <10 minute max for most labs

PRESSURE REGULATION:
Software-controlled pressure regulation from 1–21 kPa above ambient

INJECTION:
- Comes with one high-quality 1 µL Hamilton syringe
- Injection is direct from syringe to column
- Liquid injection volume: 0.01 to 0.50 µL

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Using a gas chromatograph: identifying unknown compounds
- Verification of esterification
- Quantifying substances in a mixture
- Fractional distillation
- Investigating gas chromatography

ORGANIC CHEMISTRY
- Fractional Distillation of Esters
- Enthalpy of Vaporization

Motion Detectors

Motion Detector

$79 ORDER CODE MD-BTD

The Motion Detector uses ultrasound to measure the position of carts, balls, people, and other objects.
- Measure objects as close as 15 cm and as far away as 6 m.
- Sensitivity switch reduces noise and produces higher quality data for studying dynamics carts on tracks.
- Attaches easily to the Vernier Dynamics System.
- Pivoting head allows for flexibility in the experimental setup.
- Can be used with LabQuest, LabQuest 2, LabQuest Mini, LabPro, and CBL 2. Not supported with Go!Link or EasyLink.

RANGE:	RESOLUTION:	SENSITIVITY:
0.15 to +6 meters	1 mm	2 settings

Go! Motion

$109 ORDER CODE GO-MOT

The Go!Motion has the same features as our Motion Detector but connects directly to your computer or LabQuest by USB—no other equipment is needed.

RANGE:	RESOLUTION:	SENSITIVITY:
0.15 to +6 meters	1 mm	2 settings

Motion Detector Clamp

ORDER CODE MD-CLAMP, $7

The Motion Detector Clamp attaches to the back of the Motion Detector or Go! Motion. The clamp can be attached to a variety of objects, such as table tops and ring stands.

O_2 Gas Sensor

$188 ORDER CODE O2-BTA

The O_2 Gas Sensor measures oxygen concentration in air. The wide measurement range allows it to be used to study human and cellular respiration.

- Perform or complement many experiments conducted using the CO_2 Gas Sensor.
- Includes a 250 mL bottle that can be used to study the rusting of iron or as a respiration chamber for monitoring plants and insects.

The electrochemical cell in the O_2 Gas Sensor has a life expectancy of 6-8 years. This cell can only be replaced in units of the style pictured above. Contact Vernier for information and pricing.

RANGE: 0 to 27% (0 to 270 ppt)
Normal operating temp range: 25°C (±5°C)
Operating temp range: 5-40°C (with calibration)
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.01%
10-bit (CBL, CBL 2, NXT Adapter): 0.04%

BioChambers

BioChambers provide a way for both CO_2 Gas and O_2 Gas sensors to be used at the same time in a closed system.

BioChamber 2000, 2000 mL
ORDER CODE **BC-2000, $19**

BioChamber 250, 250 mL
ORDER CODE **BC-250, $6**

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Enzyme action: testing catalase activity
- Cell respiration in peas
- Effect of temperature on cold-blooded organisms
- Oxygen gas and human respiration
- Photosynthesis and respiration
- Measure O_2 along with CO_2 in photosynthesis and respiration

HUMAN PHYSIOLOGY
- Oxygen and aerobic metabolism
- Oxygen and extraction by the lungs
- Effect of "dead space" on oxygen availability

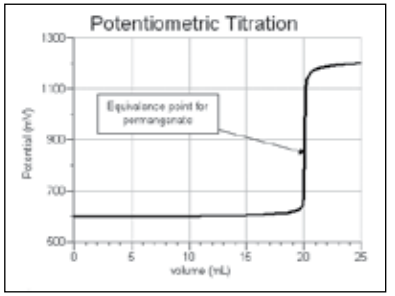
ORP Sensor

$79 ORDER CODE ORP-BTA

The Oxidation-Reduction Potential (ORP) Sensor lets you measure the ability of a solution to act as an oxidizing or reducing agent.

- Measure the oxidizing ability of chlorine in swimming pools or determine when the equivalence point has been reached in an oxidation-reduction reaction.
- Amplifier included.

RANGE: -450 to 1100 mV
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.5 mV
10-bit (CBL, CBL 2, NXT Adapter): 2 mV



ORP mV vs. *volume data for the titration of hydrogen peroxide solution with potassium permanganate*

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- An oxidation-reduction titration: the reaction of Fe^{2+} and Ce^{4+}
- Potentiometric titration of hydrogen peroxide and permanganate
- Measure oxidizing potential of chlorine in swimming pools

pH Sensor

$79 ORDER CODE PH-BTA

Our general purpose pH Sensor is an Ag-AgCl combination electrode. It can be used across disciplines, including chemistry, biology, middle school science, and environmental science.

- Includes a convenient soaking bottle and storage solution.
- pH Buffer Capsules (ORDER CODE PHB, $12) and pH Storage Solution (ORDER CODE PH-SS, $16) are available.

RANGE: 0 to 14 pH units
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.005 pH units
10-bit (CBL, CBL 2, NXT Adapter): 0.02 pH units

Tris-Compatible Flat pH Sensor

$99 ORDER CODE FPH-BTA

This specialty pH Sensor uses a double-junction electrode, making it compatible with Tris buffers and solutions containing proteins. The flat glass shape also makes it ideal for measuring the pH of semisolids such as food or soil.

GREAT WAYS TO USE THESE SENSORS!

pH SENSOR

CHEMISTRY
- Acid-base titration
- Titration of a diprotic acid: identifying an unknown
- Acid dissociation constant, K_a
- Investigating indicators
- Investigating buffers

PHYSICAL SCIENCE
- Household acids and bases
- Acid rain

BIOLOGY
- Interdependence of plants and animals
- Watershed testing

TRIS-COMPATIBLE FLAT pH SENSOR

AGRICULTURAL SCIENCE
- Soil pH

BIOLOGY
- Applications involving Tris buffers or proteinaceous solutions

EARTH SCIENCE
- Soil pH
- Soil and acid rate

Photogate and Accessories

Photogate

$45 ORDER CODE VPG-BTD

Use the Vernier Photogate to study free fall, rolling objects, collisions, and pendulums.

- Use the built-in laser detector to create a photogate through which you could drive a truck.
- Connect up to four gates in a chain.
- Includes an accessory rod for attachment to a ring stand or for adding the Ultra Pulley Attachment.

Photogate Accessories

Ultra Pulley Attachment

ORDER CODE **SPA, $24**

Add an Ultra Pulley to your Photogate to monitor motion as a string passes over the pulley or as the pulley rolls along a table.

Picket Fence

ORDER CODE **PF, $7**

Our Picket Fence has 8 opaque bars silk-screened at intervals of 5 cm directly onto clear plastic. These devices are especially good for dropping through a photogate to study free fall.

Cart Picket Fence

ORDER CODE **PF-CART, $6**

Attaches to Vernier Dynamics Carts.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS

- Determining the acceleration due to gravity
- Determining the speed of a rolling object
- Measure acceleration in an Atwood's machine
- Measure pendulum periods

Laser Pointer

ORDER CODE **LASER, $19**

This Class IIIa (<5 mW) laser pointer can be used with the Vernier Photogate to produce a gate that is wider than the normal 7.5 cm spacing, making it possible to measure the speed of an automobile or of a person running. The laser case is made of aircraft aluminum and uses two AAA batteries (included). The wavelength of the light is 650 nm.

Laser Pointer Stand

ORDER CODE **STAND, $14**

This light-weight tripod is a perfect support for the laser described above, which has a 1.1 cm outside diameter. The stand features fold-out legs and a clip attached to the adjustable ball. A socket head assembly securely holds the laser in place. This assembly allows you to accurately point the laser at the photogate. A hook-and-pile strap, integrated into one of the tripod legs, allows you to attach the laser to objects, such as ring stands and railings.

Pulley Bracket

ORDER CODE **B-SPA, $12**

The Pulley Bracket attaches an Ultra Pulley to the end of a Vernier Dynamics Track.

Photogate Bar Tape Kit

ORDER CODE **TAPE-VPG, $17**

The Photogate Bar Tape Kit contains a flexible plastic tape called "Bar Tape" and a guide that allows the tape to be used with a Vernier Photogate. The tape can be attached to objects and pulled through the photogate. This allows you to perform experiments much like what you would do with a ticker tape timer.

Polarimeter (Chemical)

$499 ORDER CODE CHEM-POL

The Chemical Polarimeter is an instrument used for measuring the rotation of plane-polarized light caused by an optically active substance. The Polarimeter is a vertical polarimeter that uses a yellow LED at 589 nm, a fixed polarizer, and a rotating polarizer (also called an analyzer) to detect changes in rotation of plane-polarized light in the presence of an optically active compound. One sample cell is included.

RANGE: ±180°
RESOLUTION*: 0.25°
LIGHT SOURCE: LED
WAVELENGTH: 589 nm
*This is the resolution of the analyzer. Typical absolute optical rotation measurements have a repeatability of ±1°.

Polarimeter Sample Cells

ORDER CODE **CELLS-POL, $66**

Package of four replacement sample cells for the Chemical Polarimeter.

Product Specifications:

- Flat-bottom glass tube
- 20 mm inner diameter x 150 mm tall
- Screen-printed ruler with centimeter markings
- Pour spout

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY/CHEMISTRY

- Determine sugar solution purity by optical rotation
- Characterize purity of inorganic syntheses yielding chiral products
- Study the kinetics of acid-catalyzed hydrolysis
- Study kinetics of enzyme-catalyzed hydrolysis
- Explore the optical activity of amino acids

ORGANIC CHEMISTRY

- Investigate reactions of natural products by optical rotation
- Characterize purity of organic syntheses yielding chiral products
- Determine enantiometric purity of optically active compounds

Power Amplifier

$199 ORDER CODE **PAMP**

Drive loads with ±10V and currents up to 1A with the Vernier Power Amplifier. The Vernier Power Amplifier works with any waveform. The Power Amplifier can drive a variety of loads, including speakers, lamps, motors, and circuits.

- Utilizes internal feedback for accurate AC waveforms and DC levels.
- Provides a steady, linearly controlled DC output for driving loads like DC motors and precise AC waveforms for driving things like speakers.
- Current limited to protect against overload and shorting.
- Current monitor function logs current.
- Class A-B push-pull amplifier provides low distortion with good efficiency.

OUTPUT VOLTAGE SWING (AMPLITUDE): ±10 V
MAX. OUTPUT CURRENT: 1 A
FREQUENCY RESPONSE: DC-20 kHz (-3 db @ 20 kHz, flat to ~15 kHz)
OUTPUT IMPEDANCE: <1 Ω

Power Amplifier Accessory Speaker

ORDER CODE **PAAS-PAMP, $99**

This kit includes a speaker and accessories used with the Vernier Power Amplifier to study mechanical waves and springs. The speaker contains a light weight metal disc glued to the speaker cone.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS

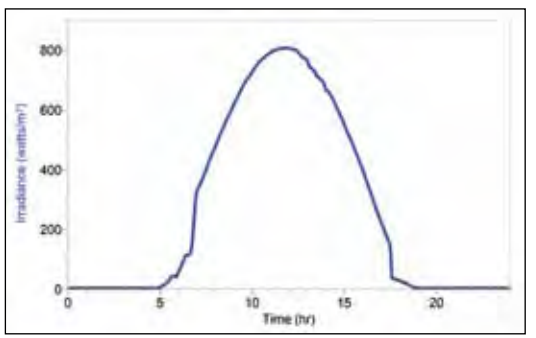
- Produce standing wave patterns by vibrating one end of a string
- Investigate longitudinal resonance by oscillating a spring with a mass attached
- Study how resistance changes with heat by supplying a low frequency waveform to a incandescent lamp
- Study RC and RLC circuits

NEW Pyranometer

$199 ORDER CODE **PYR-BTA**

The Vernier Pyranometer measures the power of electromagnetic radiation in watts per square meter. It is sensitive to the near infrared, visible, and UV ranges, where nearly all of the solar energy is concentrated. It is great for experiments with solar cells and calculating their efficiency. The sensor is weatherproof and has a dome-shaped top to allow it to work with a wide range of sun angles. The Pyranometer has a 6 m cable.

IRRADIANCE RANGE: 0 to 1100 Watts/m²
ABSOLUTE ACCURACY: ±5%
COSINE RESPONSE: 45°±1%
75°±5%



Pyranometer readings on a sunny day

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL SCIENCE

- Monitor the energy from the sun
- Determine the efficiency of a solar panel
- As a control in solar panel studies

Radiation Monitors

NEW Vernier Radiation Monitor

$169 ORDER CODE **VRM-BTD**

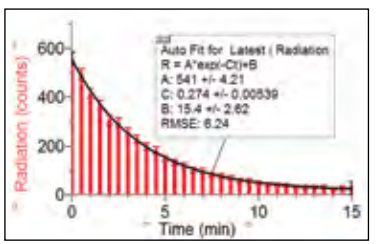
The Vernier Radiation Monitor consists of a Geiger-Mueller tube mounted in a small, rugged, plastic case. It requires no battery, getting power from the data-collection interface. A thin window protected by a metal screen allows alpha radiation to be detected, along with beta and gamma. It can be used to explore radiation statistics, measure the rate of nuclear decay, and monitor radon progeny.

Digital Radiation Monitor

$299 ORDER CODE **DRM-BTD**

The Digital Radiation Monitor consists of a Geiger-Mueller tube and a digital rate meter mounted in a small, rugged, plastic case. The unit is battery operated and can be used with or without a computer for measurement of alpha, beta, and gamma radiation.

The Geiger-Mueller tube carries a 90-day warranty.



Radioactive decay

GREAT WAYS TO USE THESE SENSORS!

PHYSICS

NUCLEAR RADIATION

- Distance and radiation
- Lifetime measurement
- Counting statistics
- Background radiation sources

CHEMISTRY

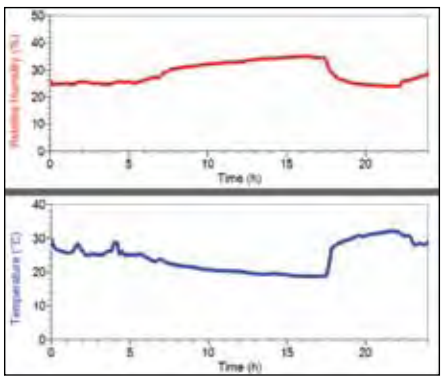
- Alpha, beta, and gamma
- Radiation shielding
- Determining the half-life of an isotope

Relative Humidity Sensor

$69 ORDER CODE RH-BTA

The Relative Humidity Sensor contains an integrated circuit that can be used to monitor relative humidity over the range of 0 to 95% (±5%). Use this sensor for weather studies, monitoring greenhouses, or for determining days when static electrical discharges could be a problem.

RANGE: 0 to 95%
TYPICAL ACCURACY: ±5%



Indoor relative humidity and temperature for a 24-hour period at

GREAT WAYS TO USE THIS SENSOR!

EARTH SCIENCE
- Air temperature and relative humidity

ENVIRONMENTAL SCIENCE
- A local weather study
- Ecocolumn investigations

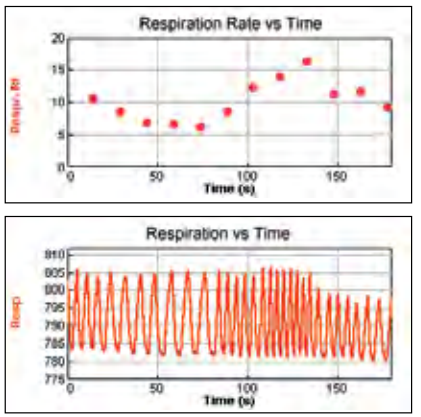
INNOVATIVE USES
- Relative humidity in caves
- Monitoring indoor relative humidity for health

Respiration Monitor Belt

$63 ORDER CODE RMB

(Requires GPS-BTA)

Use the Respiration Monitor Belt with our Gas Pressure Sensor (see below) to measure human respiration. Simply strap the belt around your chest and pump air into the belt with the hand bulb. Monitor the pressure associated with the expansion and contraction of your chest during breathing.



Monitoring respiration rate

Gas Pressure Sensor

ORDER CODE **GPS-BTA, $83**

This sensor is required for use with the Respiration Monitor Belt above. Details on page 126.

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Studying human respiration

BIOLOGY
- Control of human respiration

Rotary Motion Sensor

$169 ORDER CODE RMV-BTD

Monitor angular motion precisely and easily with the Rotary Motion Sensor.

- Collect angular displacement, angular velocity, and angular acceleration data.
- Direction sensitive.
- Measure linear position to a fraction of a millimeter.

STANDARD RESOLUTION: 1.0° (angular velocity up to 30 rev/s)

HIGH RESOLUTION: 0.25° (angular velocity up to 7.5 rev/s)

Rotational Motion Accessory Kit

ORDER CODE **AK-RMV, $110**

This accessory kit is used to study the motion of a physical pendulum; the rotational inertia of disks, rings, and point masses; and the conservation angular momentum. The kit includes:

- Two 8.9 cm diameter, 0.6 cm thick solid aluminum disks
- One steel disk with 2.9 cm central hole
- One plastic hub to hold the steel disk on the 3-step pulley
- One 38 cm hollow aluminum rod
- One Ultra Pulley
- One Ultra Pulley Swivel Mount, which allows the pulley to be mounted on the Rotary Motion Sensor

For more details, visit **www.vernier.com/ak-rmv**

Rotary Motion Motor Kit

ORDER CODE **MK-RMV, $12**

This kit includes a small electric motor with pulley, rubber band belt, motor clip, and mounting screw. The motor can be attached to the Rotary Motion Sensor, and be used as an analog tachometer, or generator. You can also perform experiments that investigate motor efficiency in different conditions. For more details, visit **www.vernier.com/mk-rmv**

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Atwood's machine experiments
- Measuring moments of inertia
- Torque experiments
- Physical pendulum
- Conservation of angular momentum

Salinity Sensor

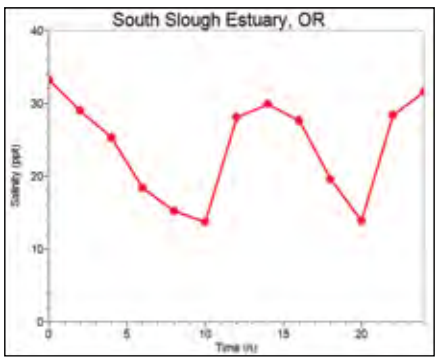
$92 ORDER CODE SAL-BTA

The Salinity Sensor easily and precisely measures the total dissolved salt content in ocean or brackish water.

- Measure water with a wide variety of salinities, from brackish water to ocean water, and even hyper-saline environments.
- Study how salinity affects buoyancy, or monitor salinity values in estuaries where fresh water mixes with salty ocean water.

RANGE: 0 to 50 ppt

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.02 ppt
10-bit (CBL, CBL 2, NXT Adapter): 0.08 ppt



Measuring salinity in an estuary

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL SCIENCE
- Studying salinity in an estuary
- Measure salinity in ocean or brackish water

INNOVATIVE USES
- GIS mapping enhances salinity
- Investigating salinity levels
- Ionic and molecular compounds
- Find the relationship between conductivity and concentration

Soil Moisture Sensor

$95 ORDER CODE SMS-BTA

The Soil Moisture Sensor uses capacitance to measure the water content of soil. Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of soil is reported in percent. Use it to conduct experiments in ecology, environmental science, agricultural science, horticulture, biology, and more.

RANGE: 0 to 45% volumetric water content

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.1%
10-bit (CBL, CBL 2, NXT Adapter): 0.4%

Monitoring changes in soil moisture in ecocolumns

GREAT WAYS TO USE THIS SENSOR!

EARTH SCIENCE
- Measure the loss of soil moisture over time due to evaporation and plant uptake
- Evaluate optimum soil moisture contents for various species of plants
- Monitor soil moisture content to control irrigation in greenhouses

ENVIRONMENTAL SCIENCE
- Manage garden soil moisture
- Ecocolumn investigations
- Pollution study

AGRICULTURAL SCIENCE
- Soil Moisture

Sound Level Meter

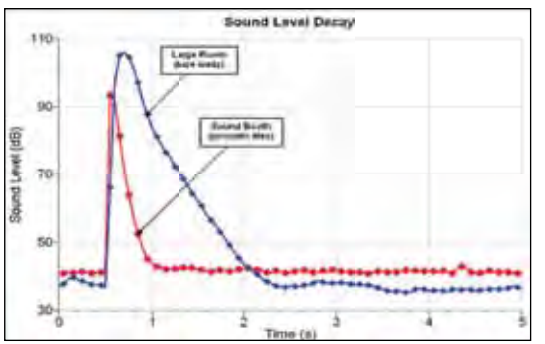
$165 ORDER CODE SLM-BTA

Measure sound level in decibels (dB) with a Sound Level Meter. An output port on the meter records sound level data. A switch on the meter is used to select dBA or dBC weighting. The Sound Level Meter also has an LCD panel, which allows you to use it as a standalone device.
A dB range switch and a response switch provide flexibility in standalone mode.

RANGE: 35 to 130 dB

ACCURACY: 1.5 dB at 94 dB

FREQUENCY RESPONSE: 31.5 to 8,000 Hz



Sound level decay in two rooms

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Study reverberation times
- Investigating airport noise
- Investigate room acoustics
- Measuring sound levels at a pep rally
- Investigate traffic noise
- Use for environmental noise studies

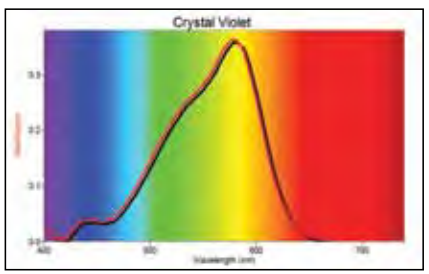
SpectroVis® Plus Spectrophotometer

$459 ORDER CODE SVIS-PL

SpectroVis Plus is an affordable, portable, visible to near-IR spectrophotometer and fluorometer. Details on page 49.

RANGE: 380–950 nm
Fluorescence excitation centered at 405 nm and 500 nm

RESOLUTION:
~2.5 nm optical resolution, 570 wavelengths, 1 nm reporting intervals



Absorbance spectrum of crystal violet

SpectroVis Optical Fiber

ORDER CODE **SVIS-FIBER, $69**

Turn your SpectroVis spectrophotometer into an emissions spectrometer using the SpectroVis Optical Fiber insert. For more details, see **www.vernier.com/svis-fiber**

For more on spectrometers, see pp. 48–49.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Beer's law
- Kinetics studies
- Determine chemical composition based on absorption spectra

ORGANIC CHEMISTRY
- Grignard Formation of Crystal Violet
- Synthesis of Fluorescein
- Synthesis of Methyl Orange and Its Application to Textiles

PHYSICS
- Emission spectra of gases
- Emission spectra of lamps

BIOLOGY
- Visible spectrum of chlorophyll
- Photosynthesis

Spirometer and Replacement Parts

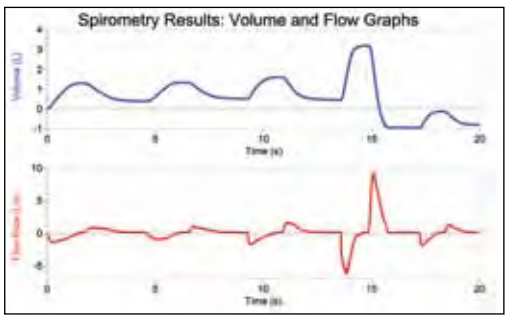
Spirometer

$199 ORDER CODE SPR-BTA

Use the Spirometer to perform a variety of tests related to air flow and lung volume.

- Designed to measure human respiration at rest and during moderate activity.
- Includes a removable flow head (22 mm ID/30 mm OD) for easy cleaning and sterilization, in addition to 5 disposable mouthpieces, 1 disposable bacterial filter, and 2 nose clips.

FLOW RANGE: ±600 L/min **DEAD SPACE:** 93 mL



Measuring lung volume

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Lung volumes and capacities
- Respiratory response to physiologic challenges
- Analysis of lung function
- Oxygen and aerobic metabolism

Disposable Bacterial Filter
(pkg. of 10)

ORDER CODE **SPR-FIL, $30**

Use of the disposable microbacterial filter significantly reduces how often you will need to sterilize your spirometer's flow head. The filter's 30 mm ID opening allows for an easy, air-tight fit to the flow head.

Disposable Mouthpiece
(pkg. of 30)

ORDER CODE **SPR-MP, $10**

For a more sterile environment, use the cardboard mouthpieces to help eliminate the spreading of contagious material between students.

Noseclip *(pkg. of 10)*

ORDER CODE **SPR-NOSE, $10**

These plastic, foam-padded noseclips help increase the precision of your spirometry results by eliminating the escape of air through the nostrils during testing.

Extra Spirometer Flow Head

ORDER CODE **SPR-FLOW, $60**

An extra flow head eliminates equipment downtime while sterilizing your original flow head. The flow head consists of a polycarbonate outer body with a stainless steel inner mesh.

O_2 Gas Sensor to Spirometer Adapter

ORDER CODE **O2-SPR, $8**

This adapter facilitates the connection between an Oxygen Gas Sensor and a Spirometer when measuring the oxygen gas concentration and flow rate of exhaled air.

Temperature Probes

Stainless Steel Temperature Probe

$29 ORDER CODE TMP-BTA

This rugged and durable temperature probe has a sealed stainless steel shaft and tip that can be used in organic liquids, salt solutions, acids, and bases.

RANGE: -40 to 135°C

12-bit Resolution (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ):
0.17°C (-40 to 0°C)
0.03°C (0 to 40°C)
0.1°C (40 to 100°C)
0.25°C (100 to 135°C)

10-bit Resolution (CBL, CBL 2, NXT Adapter):
0.68°C (-40 to 0°C)
0.12°C (0 to 40°C)
0.4°C (40 to 100°C)
1.0°C (100 to 135°C)

Extra-Long Temperature Probe

$79 ORDER CODE TPL-BTA

This probe has a 30-meter (100 ft) cable. It is designed for remote, outdoor temperature sensing or for measuring temperature at various depths in lakes and streams.

RANGE: -50 to +150°C
12-bit Resolution (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.07°C
10-bit Resolution (CBL, CBL 2): 0.3°C

For USB temperature probe, see page 17.

GREAT WAYS TO USE THE STAINLESS STEEL TEMPERATURE PROBE!

CHEMISTRY
- Endothermic and exothermic reactions
- Freezing and melting of water
- Heat of fusion of ice
- Pressure-temperature relationship in gases
- Evaporation and intermolecular attractions

MIDDLE SCHOOL
- Heating of land and water
- The greenhouse effect
- Absorption of radiant energy

PHYSICS
- Newton's law of cooling

BIOLOGY
- Energy in food
- Biodiversity and ecosystems
- Aerobic respiration
- Dissolved oxygen *vs.* temperature

PHYSICAL SCIENCE
- Boiling temperature of water
- Freezing temperature of water
- Insulation

Surface Temperature Sensor

$23 ORDER CODE STS-BTA

Featuring an exposed thermistor that results in an extremely rapid response time, the Surface Temperature Sensor is ideal for situations in which low thermal mass or flexibility is required, or for a skin temperature measurement. This design allows for use in air and water.

RANGE: -25 to 125°C

12-bit Resolution (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ):
0.08°C (-25 to 0°C)
0.03°C (0 to 40°C)
0.1°C (40 to 100°C)
0.25°C (100 to 125°C)

10-bit Resolution (CBL, CBL 2, NXT Adapter):
0.3°C (-25 to 0°C)
0.12°C (0 to 40°C)
0.4°C (40 to 100°C)
1.0°C (100 to 125°C)

Infrared Thermometer

$169 ORDER CODE IRT-BTA

The Infrared Thermometer is a non-contact, fast-responding temperature measuring device. The sensor works by measuring the infrared radiation emitted by objects. You simply point the sensor at the object and read its temperature.

RANGE: -20 to 400°C

ACCURACY: ±3% of reading or ±3°C, whichever is greater at 18 to 28°C ambient operating temperature

EMISSIVITY: preset 0.95

GREAT WAYS TO USE THESE SENSORS!

CHEMISTRY
- Endothermic and exothermic reactions
- Freezing and melting of water
- Heat of fusion of ice
- Pressure-temperature relationship in gases
- Evaporation and intermolecular attractions

INFRARED THERMOMETER SENSOR

INNOVATIVE USES
- Measure the temperature of hard-to-reach objects
- Investigate skin temperature
- Compare the temperature of your palm, forearm, or foot
- Compare the temperature of cars parked in the sun

Wide-Range Temperature Probe

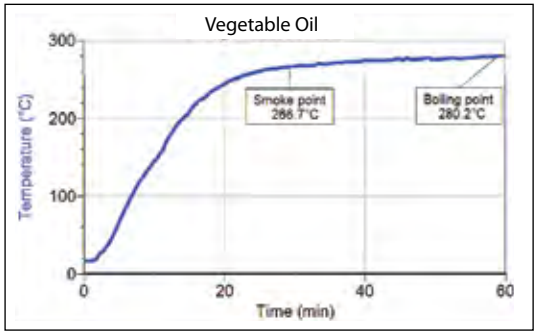
$79 ORDER CODE WRT-BTA

This temperature probe features a temperature range of -20°C to 330°C, which allows for melting point determinations of most organic compounds.
- Sealed, stainless steel shaft can be used in organic liquids, salt solutions, acids, and bases.
- Long enough to extend into flasks and other common glassware.
- Narrow diameter allows it to fit snugly in openings designed for thermometers.

RANGE SETTINGS: -20 to 330°C

ACCURACY: ±0.1°C throughout the temperature range

12-bit Resolution (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.1°C



Temperature of vegetable oil using a Wide-Range Temperature Probe

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Fractional distillation
- Melting temperature of organic compounds
- Determining enthalpy of a chemical reaction
- Synthesis and analysis of aspirin

ORGANIC CHEMISTRY
- Determination of a Boiling Point
- The Diels-Alder Reaction
- Fractional Distillation of Esters
- Isolation and Epoxidation of a Natural Product
- Friedel-Crafts Acylation of Ferrocene
- Synthesis of Fluorescein

Temperature Probes (continued)

Thermocouple

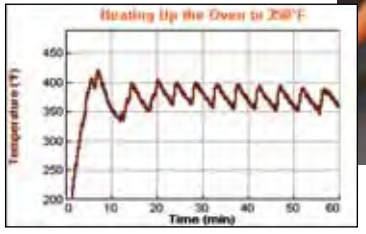
$69 ORDER CODE TCA-BTA

The Thermocouple uses type-K thermocouple wire to measure temperatures between -200˚C and 1400˚C.

- Measure liquid nitrogen temperatures at -196˚C and flame temperatures up to 1400˚C.
- Internal ice-point compensation means you do not need to place a reference wire in an ice-water bath.
- Individually calibrated.

RANGE:
-200 to 1400°C

TYPICAL ACCURACY:
0 to 900°C: ±2°C
-200 to 0°C: ±5°C
900 to 1400°C: ±15°C



Temperature cycles of an oven using a Thermocouple

Taking temperature of an open flame

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Compare the temperature at different parts of a flame
- Compare the temperature of different flames
- Temperature cycles of an oven
- Monitor temperature of liquid nitrogen or dry ice
- Determine the melting point of copper or other solids

Turbidity Sensor

$112 ORDER CODE TRB-BTA

Use the Turbidity Sensor to measure the turbidity of freshwater or seawater samples in NTU (the standard unit used by most water collection agencies and organizations).

- Small, sleek design and simple setup make it easy to use at the collection site or in the classroom.
- Monitor precipitate formation or algae and yeast populations in chemistry and biology classes.
- Includes high-quality Hach StablCal™ 100 NTU standard for quick calibration and a high-grade glass cuvette for your water sample. A set of six additional glass Turbidity Bottles are available (ORDER CODE TRB-BOT, $27).

RANGE: 0 to 200 NTU

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.25 NTU
10-bit (CBL, CBL 2, NXT Adapter): 1.0 NTU

Measuring turbidity of a stream

GREAT WAYS TO USE THIS SENSOR!

WATER QUALITY
- Monitor water clarity

ENVIRONMENTAL SCIENCE
- Long-term water monitoring
- Pollution study

EARTH SCIENCE
- Water quality: turbidity
- Water treatment

UVA and UVB Sensors

$106 ORDER CODE UVA-BTA

$107 ORDER CODE UVB-BTA

We have two different sensors for measuring the intensity of ultraviolet radiation. One responds primarily to UVA radiation (320 to 375 nm), and another responds primarily to UVB radiation (290 to 320 nm). UVB radiation is commonly associated with sunburns, cataracts, and skin cancer. UVA radiation, while responsible for suntans, is also a cause of premature aging of the skin and some types of skin cancer. Which sensor you use will depend upon the particular experiment you want to perform.

UVA SENSOR
Great for use with UV lamps.

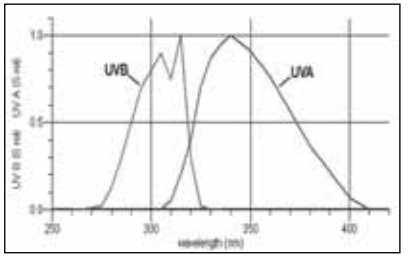
RANGE: 0 to 18,000 mW/m²
Wavelength sensitivity region approximately 320 to 375 nm
UV peak sensitivity: one volt per 3940 mW/m² at 340 nm

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 5 mW/m²
10-bit (CBL, CBL 2, NXT Adapter): 20 mW/m

UVB SENSOR
Great for use in the sun. Recommended for our lab books.

RANGE: 0 to 900 mW/m²
Wavelength sensitivity region approximately 290 to 320 nm
UV peak sensitivity: one volt per 204 mW/m² at 315 nm

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.25 mW/m²
10-bit (CBL, CBL 2, NXT Adapter): 1 mW/m



Spectral response of the UV Sensors

GREAT WAYS TO USE THESE SENSORS!

EARTH SCIENCE
- Compare absorption in glasses
- Comparing sunscreens
- UV light and clothing

ENVIRONMENTAL SCIENCE
- Collect local weather data
- UV investigations

Voltage Probes

Differential Voltage Probe

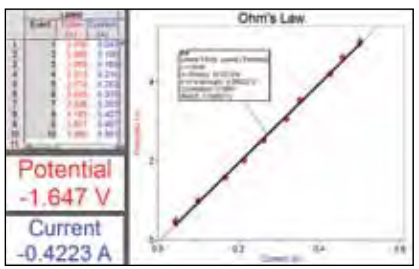
$39 ORDER CODE DVP-BTA

The Differential Voltage Probe is designed for exploring basic principles of electricity, including series and parallel circuits.

- Ideal for use in most battery and bulb circuits.
- Can be used to study low-voltage AC and DC circuits.
- Combine with a Current Probe to explore Ohm's law, phase relationships, and much more.

This sensor differs from our Voltage Probe (see next column) in that neither of the clips are grounded, making it possible to use two probes in the same circuit simultaneously.

RANGE: -6.0 to +6.0 V **INPUT IMPEDANCE:** 10 MΩ
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 3.1 mV
10-bit (CBL, CBL 2, NXT Adapter): 12.5 mV



Logger Pro *graph showing Ohm's law using the Current Probe, Differential Voltage Probe, and the Vernier Circuit Board*

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Ohm's law
- Series and parallel circuits
- Electrical energy
- Capacitors

PHYSICAL SCIENCE
- Battery and bulb investigations

INNOVATIVE USE
- For laboratory voltage measurement

Voltage Probe

$12 ORDER CODE VP-BTA

This Voltage Probe can be used to measure the potential in direct-current or alternating-current circuits. In chemistry, physical science, or middle school science classes, the Voltage Probe can be used to measure voltages developed in a variety of electrochemical (voltaic) cells.

RANGE: -10 to +10 V
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, SensorDAQ): 0.005 V (5 mV)
10-bit (CBL, CBL 2): 0.020 V (20 mV)

30-Volt Voltage Probe

$49 ORDER CODE 30V-BTA

This sensor is used to measure voltages in the range of -30 to +30 volts. Use this sensor in experiments that involve voltages larger than 10 volts, such as when working with large solar panels. Since this voltage probe covers such a wide voltage range, its resolution is lower than our Differential Voltage Probe, which we recommend for most experiments.

RANGE: -30 to +30 V

GREAT WAYS TO USE THESE SENSORS!

VOLTAGE PROBE

CHEMISTRY
- Establishing a table of reduction potentials: micro-voltaic cell
- Lead storage batteries

PHYSICS
- Capacitor charging

MIDDLE SCHOOL
- Fruit and metal voltaic cells

30-VOLT VOLTAGE PROBE

INNOVATIVE USES
- Measure output from large solar panels
- Measure voltage in do-it-yourself projects

Watts Up Pro

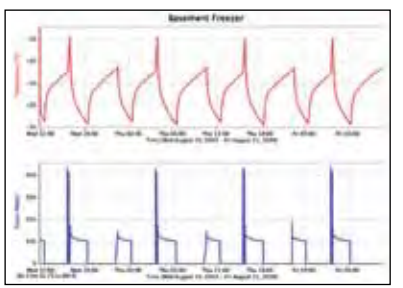
$145 ORDER CODE WU-PRO

Watts Up Pro measures real-time energy use of common electrical devices. Find out which costs more: running a hairdryer for 10 minutes or leaving on a lamp all afternoon? Measures potential, current, power, and cumulative cost.

- Connects to the USB port on your computer or LabQuest—no other devices needed.
- Use at the same time as a LabQuest, LabQuest Mini, LabPro, or Go!Link to monitor electricity usage in combination with other data, such as temperature, light, and relative humidity.
- The LCD panel on Watts Up Pro allows it to be used as a standalone device.

The Watts Up Pro carries a one-year warranty.

VOLTAGE: 120 V
MINIMUM MEASURABLE POWER: 0.5 watts
ACCURACY: ±1.5%, + 3 counts of the displayed value



Measuring temperature and power consumption in a basement freezer

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Long-term monitoring of devices
- How can I save money?
- Investigate phantom load
- Compare energy use of different types of light bulbs
- Study energy use of different devices
- Analyze energy use of different wattage light bulbs
- Study energy use in charging electric cars

Wireless Dynamics Sensor System (WDSS)

$249 ORDER CODE WDSS

The WDSS combines a 3-axis accelerometer, force sensor, and altimeter into one unit that communicates wirelessly with your computer via Bluetooth®.

- Use it with your Bluetooth-enabled computer and Logger *Pro* to collect data free of friction due to cables.
- Internal data storage capacity allows you to use it as a standalone data logger. Great for roller coaster physics.

(Requires LabQuest 2 or a Bluetooth-enabled computer and Logger Pro *software. Can also be used with an original LabQuest with a Bluetooth dongle. See below.)*

INTERNAL DATA STORAGE CAPACITY: 240,000 points
MAXIMUM SAMPLING RATE: 1000 samples/s

FORCE	**RANGE:** ±50 N **RESOLUTION:** 0.006 N (<10 N) 0.03 N (>10 N)
ACCELEROMETERS *(for each axis)*	**RANGE:** ±50 m/s² (±5 g) **RESOLUTION:** 0.04 m/s²
ALTIMETER	**ALTITUDE CHANGE RANGE:** +/-200 m **RESOLUTION:** 1 m

Bluetooth USB Dongle Radio

ORDER CODE **BLUE-USB, $35**

Each computer or original LabQuest used with a WDSS must have a Bluetooth radio. (Note: LabQuest 2 has a built-in Bluetooth radio.) This convenient USB dongle adds Bluetooth capabilities to any Windows XP SP2, Vista, or Mac OS X 10.3 or newer computer that lacks Bluetooth.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS

- Roller coaster accelerations
- Skateboarding
- Newton's second law
- Newton's third law
- Centripetal acceleration on a turntable or a merry-go-round
- Force and acceleration in simple harmonic motion

Do You Have Older Sensors?

ADAPTERS FOR OLDER VERNIER SENSORS		
SENSOR	**ADAPTER/CABLE**	**PRICE**
Analog "-DIN" Sensor	DIN-BTA	$5
Motion Detector *(with removable cable)*	MDC-BTD *(cable)*	$5
ULI Motion Detector *(older, non-removable cable)*	CBL-RJ11	$5
Radiation Monitor *(older model)*	RAD-BTD *(cable)*	$5
Rotary Motion Sensor *(older model)*	ROT-BTD	$5
Vernier Photogate *(with removable cable)*	PG-BTD *(cable)*	$5

DIN-to-BTA Adapter

ORDER CODE **DIN-BTA, $5**

BTA-to-DIN Adapter

ORDER CODE **BTA-DIN, $5**

DIN-to-BTA Adapter

Our older analog sensors have a round "DIN" 5-pin plug. Our new sensors have a "BT" (British Telecom) connector. Do you have an older-style DIN sensor with a round 5-pin plug that you want to plug into a LabQuest, LabQuest Mini, LabPro, Go!Link, or CBL 2? You need a DIN-to-BTA adapter (pictured here). The sensor will not auto ID, but it will work just fine.

CABLES / ADAPTERS / POWER SUPPLIES		
PART NAME	**CODE**	**PRICE**
AC Adapter *(for LabQuest or LabQuest Mini)*	LQ-PS	$11
AC Adapter *(for LabPro, CBL 2, or CBL)*	IPS	$12
Analog Sensor Extension Cable *(2 m)*	EXT-BTA	$12
Digital Sensor Extension Cable *(2 m)*	EXT-BTD	$12
Analog Protoboard Connector	BTA-ELV	$10
Digital Protoboard Connector	BTD-ELV	$10
Calculator-to-Calculator Link Cable	TI-CLC	$5
Short Calculator Link Cable	TI-SLC	$5
Go!Motion to Computer Cable	GMC-USB	$5
LabPro→USB Cable *(Mac or PC)*	CB-USB	$5
Analog Bare Wire Cable	CB-BTA	$5
Digital Bare Wire Cable	CB-BTD	$5
Mini-to-Standard USB Adapter	MINI-USB	$5
Motion Detector Cable *(LabQuest, LabPro or CBL)*	MDC-BTD	$5
Standard-to-Mini USB Adapter	USB-MINI	$5

MORE ONLINE – Can't find the adapter you need? Check our complete list of adapters (including pictures) at **www.vernier.com/adapters**

Partners

Texas Instruments
Flinn Scientific
Bio-Rad
Bodelin
LTF Laying the Foundation
LEGO education
Globe
Ward's Natural Science
Promethean
National Instruments
Ocean Optics
APS AP Strategies
PLTW
OHAUS

"With Vernier, every telephone call—from ordering, asking a question or having a sensor issue to solve—is handled capably and professionally with friendliness and good humor."

Cathy Theisen, Richfield High School, Richfield, MN

SENSOR ACCESSORIES AND REPLACEMENT PARTS

PART NAME	CODE	PRICE
Blood Pressure Sensor		
Small Blood Pressure Cuff	CUFF-SM	$32
Large Blood Pressure Cuff	CUFF-LG	$35
Bottles		
Nalgene Bottle *(250 mL)*	CO2-BTL	$3
Primary Productivity Kit	PPK	$44
Turbidity Bottles *(pkg. of 6)*	TRB-BOT	$27
Water Quality Bottles *(pkg. of 8)*	WQ-BOT	$28
Charge Sensor		
Electrostatics Kit	ESK-CRG	$109
High Voltage Electrostatics Kit	HVEK-CRG	$249
CO_2 and/or O_2 Gas Sensor		
BioChamber 250 *(250 mL) (2 openings)*	BC-250	$6
BioChamber 2000 *(2000 mL) (2 openings)*	BC-2000	$19
Grommets for CO_2 and O_2 (pkg. of 10)	CO2-GROM	$6
Respiration Chamber *(250 mL) (1 opening)*	CO2-BTL	$3
Colorimeter/Spectrometer		
Colorimeter/Spectrometer Cuvettes *(pkg. of 100)*	CUV	$15
Cuvette Rack	CUV-RACK	$9
UV-VIS Spectrometer Cuvettes *(pkg. of 100)*	CUV-UV	$89
Conductivity Probe		
Conductivity Low Standard *(500 mL)*	CON-LST	$16
Conductivity Medium Standard *(500 mL)*	CON-MST	$16
Conductivity High Standard *(500 mL)*	CON-HST	$16
Dissolved Oxygen Probe (Original)		
DO Calibration Solution *(60 mL)*	DO-CAL	$4
DO Filling Solution *(130 mL)*	FS	$6
DO Polishing Strips	PS	$4
DO Probe Membrane Cap	MEM	$13
Dissolved Oxygen Probe (Optical)		
Optical DO Probe Replacement Cap	ODO-CAP	$49
Optical DO Probe Metal Guard	ODO-GRD	$45
DO Calibration Solution *(60 mL)*	DO-CAL	$4
EKG Sensor		
EKG Electrodes	ELEC	$12
Ethanol Sensor		
Ethanol Cap Assemblies (3)	ETH-CAPS	$10
Ethanol Stopper	ETH-STOP	$4
Ethanol Tape	ETH-TAPE	$3

PART NAME	CODE	PRICE
Gas Pressure Sensor		
Pressure Sensor Accessories Kit	PS-ACC	$10
#1 1-Hole Rubber Stopper	PS-STOP1	$1
#5 2-Hole Rubber Stopper	PS-STOP5	$1.50
Luer Lock Connector	PS-LUER	$1
Plastic 2-Way Valve	PS-2WAY	$2
Plastic Tubing	PS-TUBING	$1
Plastic Tubing Clamps *(pkg. of 100)*	PTC	$32
Stopper Stem	PS-STEM	$1
Syringe (20 mL, plastic)	PS-SYR	$1
Ion-Selective Electrodes		
ISE Ammonium Replacement Module*	NH4-MOD	$59
ISE Calcium Replacement Module*	CA-MOD	$59
ISE Nitrate Replacement Module*	NO3-MOD	$59
ISE Ammonium Low Standard *(500 mL)*	NH4-LST	$16
ISE Ammonium High Standard *(500 mL)*	NH4-HST	$16
ISE Calcium Low Standard *(500 mL)*	CA-LST	$16
ISE Calcium High Standard *(500 mL)*	CA-HST	$16
ISE Chloride Low Standard *(500 mL)*	CL-LST	$16
ISE Chloride High Standard *(500 mL)*	CL-HST	$16
ISE Nitrate Low Standard *(500 mL)*	NO3-LST	$16
ISE Nitrate High Standard *(500 mL)*	NO3-HST	$16
Melt Station		
Melt Station Capillary Tubes *(pkg. of 100)*	MLT-TUBE	$15
Mini GC/Mini GC Plus		
GC Septa *(pkg. of 4)*	GC-SEP	$25
GC Syringe, 1 µL Hamilton	GC-SYR-MIC	$79
Motion Detector		
Motion Detector Clamp	MD-CLAMP	$7
Optics		
Color Mixer Kit	CM-OEK	$150
Diffraction Apparatus	DAK	$549
Mirror Set	M-OEK	$59
Optics Expansion Kit	OEK	$169
Polarizer/Analyzer Kit	PAK-OEK	$74
pH Sensor		
Microstirrer	MSTIR	$9
pH Buffer Capsules	PHB	$12
BNC pH Electrode *(for EA-BTA; with BNC connector)*	7120B	$41

PART NAME	CODE	PRICE
pH Sensor (continued)		
pH Storage Bottles *(pkg. of 5)*	BTL	$10
pH Storage Solution *(500 mL)*	PH-SS	$16
Photogate		
Cart Picket Fence	PF-CART	$6
Laser Pointer	LASER	$19
Laser Pointer Stand	STAND	$14
Photogate Bar Tape Kit	TAPE-VPG	$17
Picket Fence	PF	$7
Pulley Bracket	B-SPA	$12
Ultra Pulley Attachment	SPA	$24
Polarimeter (Chemical)		
Polarimeter Sample Cells *(pkg. of 4)*	CELLS-POL	$66
Power Amplifier		
Accessory Speaker	PAAS-PAMP	$99
Rotary Motion		
Rotary Motion Accessory Kit	AK-RMV	$110
Rotary Motion Motor Kit	MK-RMV	$12
Centripetal Force Apparatus	CFA	$399
Salinity Sensor		
Salinity Standard *(35 ppt salinity, 500 mL)*	SAL-ST	$16
Spirometer		
Disposable Bacterial Filter *(pkg. of 10)*	SPR-FIL	$30
Disposable Mouthpiece *(pkg. of 30)*	SPR-MP	$10
Noseclip *(pkg. of 10)*	SPR-NOSE	$10
Spirometer Flow Head	SPR-FLOW	$60
O_2 Gas Sensor to Spirometer Adapter	O2-SPR	$8
Turbidity Sensor		
Turbidity Bottles *(pkg. of 6)*	TRB-BOT	$27
Turbidity Cuvette and Standard	TRB-ACC	$35
Vernier Dynamics System		
Bumper and Launcher Kit	BLK	$89
Cart Fan	FAN-VDS	$60
Friction Pad	PAD-VDS	$30
Vernier Projectile Launcher		
Independence of Motion Accessory	IOM-VPL	$49
Projectile Stop	PS-VPL	$40
Time of Flight Pad	TOF-VPL	$77
Wireless Dynamic Sensor System Accessories		
Bluetooth USB Dongle Radio	BLUE-USB	$35

*ISE modules have a life expectancy of 1–2 years. We recommend that you do not purchase ISE replacement modules too far in advance of their expected time of use; degradation occurs while replacement modules are stored on the shelf.

$49 a

$15 b

$109 c

$109 d

a. LabQuest Viewer

ORDER CODE **LQ-VIEW, $49**

Teach students how to use LabQuest by projecting your LabQuest screen via Wi-Fi. Remotely monitor student progress by viewing student LabQuests.

- Use built-in Wi-Fi on LabQuest 2
- Use Wi-Fi dongle for the original LabQuest
- Compatible with both Mac and PC

Includes a site license for every teacher's computer in your school or college department.

b. LabQuest 2 Lab Armor

ORDER CODE **LQ2-ARMOR, $15**

Add extra protection from spills and falls with Lab Armor for LabQuest 2. Molded rubber material helps prevent spills from getting into open ports.

c. LabQuest 2 Charging Station

ORDER CODE **LQ2-CRG, $109**

Original LabQuest Charging Station

ORDER CODE **LQ-CRG, $109**

Multi-bay charging capability for your original LabQuest or LabQuest 2.

Want a way to charge and store your LabQuests? The LabQuest Charging Station is the perfect solution. Each charging station has four charging slots that support either the original LabQuest or the LabQuest 2. LEDs on the charging station indicate the charging status. The compact design uses desk space efficiently.

d. IMPROVED LabQuest Battery Boost 2

ORDER CODE **LQ-BOOST2, $109**

The Battery Boost 2 is a rechargeable external battery for your original LabQuest or LabQuest 2. Collect data for extended periods where AC power is not available.

LabQuest Accessories

LABQUEST 2
ACCESSORIES / REPLACEMENT PARTS

PART NAME	CODE	PRICE
LabQuest 2 Charging Station	LQ2-CRG	$109
LabQuest 2 Lab Armor	LQ2-ARMOR	$15
LabQuest 2 Stand	LQ2-STN	$5
LabQuest Computer Cable	LQ-CB-USB	$5
LabQuest Power Supply	LQ-PS	$11
LabQuest Tether *(pkg. of 5)*	LQ-TETH-5	$5
LabQuest Lanyard	LQ-LAN	$5
LabQuest 2 Battery	LQ2-BAT	$19
LabQuest Battery Boost 2	LQ-BOOST2	$109
LabQuest 4GB SD Card	LQ-SD4	$12
LabQuest 2 Stylus *(pkg. of 5)*	LQ2-STYL-5	$5
LabQuest International Power Supply	LQ-PS-INTL	$16

ORIGINAL LABQUEST
ACCESSORIES / REPLACEMENT PARTS

PART NAME	CODE	PRICE
LabQuest Charging Station	LQ-CRG	$109
LabQuest Computer Cable	LQ-CB-USB	$5
LabQuest Power Supply	LQ-PS	$11
LabQuest Tether *(pkg. of 5)*	LQ-TETH-5	$5
LabQuest Lanyard	LQ-LAN	$5
LabQuest Battery	LQ-BAT	$19
LabQuest Battery Boost 2	LQ-BOOST2	$109
LabQuest 4GB SD Card	LQ-SD4	$12
LabQuest Stand	LQ-STN	$12
LabQuest Stylus *(pkg. of 5)*	LQ-STYL-5	$5
LabQuest International Power Supply	LQ-PS-INTL	$16
LabQuest Wi-Fi USB Adapter	WIFI-USB	$59

PROFESSIONAL DEVELOPMENT

About Our Trainers

Vernier's Professional Training Staff includes:

- 40 current or former classroom science and math teachers, all of whom have used Vernier equipment and software in their own classes.
- Teachers who, as a group, possess a total of 992 years of teaching experience, encompassing all subject areas and grade levels.
- Educators with prestigious teaching awards in their respective states and teaching subject areas, including 7 Presidential Awardees, 2 Woodrow Wilson Dreyfus Master Teachers, 3 Tandy Technology Scholars, one Radio Shack Technology Awardee, one GTE Gift Awardee, one Excellence in Pre-College Physics Teaching Awardee, and a variety of science educator of the year recipients in Arizona, Delaware, Kentucky, Maryland, New York, Oregon, South Dakota, Virginia, Washington, and Wisconsin, and many other awards.
- Authors of more than 60 science books and lab manuals (including many of our own Vernier lab books).

IMPROVING TEACHER EFFECTIVENESS

Data-collection training gives teachers the skills to teach with the latest in sensor technology. All teachers will conclude their Vernier training with a certificate of completion indicating the number of hours spent in training. For more information on probeware and student achievement, see page 147.

Graduate Education Credit Available

NEED TO EARN CREDIT?

Attend one of our workshops that is four hours or longer, and you will have the opportunity to earn two (quarter) Graduate Science credit hours through the Portland State University Center for Science Education (approximate cost $190, payable to PSU). For more details on this professional development option, see **www.vernier.com/gradcred**

Many states offer Continuing Education Credit or clock hours for attendance at workshops held at professional conventions or at in-service training. We are happy to provide documentation of your attendance at any of our hands-on or demonstration workshops, hundreds of which are offered throughout the country each year. For more details, contact us at **pd@vernier.com**

FREE Hands-On, Data-Collection Workshops

LabQuest 2 | Computer Data Collection

4 HOUR

Calling all science educators! Step out of your classrooms, roll up your sleeves, and join us in the Vernier laboratory for a four-hour exploration of the latest and greatest in probeware and data-collection technology. Learn how to integrate our technology into your chemistry, biology, physics, middle school science, physical science, and Earth science curriculum. Contact us or visit our web site for up-to-date information and registration.

Perfect for science educators who:

- Want to evaluate our award-winning, data-collection technology.
- Are new to data collection.
- Need a refresher course on their Vernier equipment.
- Want to learn from the experts.

Attendees receive:

- Four hours of free training
- Light lunch or dinner
- Workshop Training Manual on CD
- Discount on LabQuest 2 Training Package or LabQuest Mini Training Package

2013 HANDS-ON DATA-COLLECTION WORKSHOPS

SPRING WORKSHOPS	
Alabama	Birmingham, Montgomery
Arkansas	Little Rock
California	Pasadena, Riverside, San Francisco, San Jose, Stockton
Connecticut	Stamford
Delaware	Dover
Florida	Fort Lauderdale, Jacksonville, Orlando, Tampa
Georgia	Atlanta, Augusta
Louisiana	Baton Rouge
Maryland	Baltimore
Mississippi	Jackson
New Jersey	Newark, Princeton
North Carolina	Charlotte, Greensboro, Raleigh/Durham
Pennsylvania	Philadelphia
South Carolina	Columbia
Tennessee	Chattanooga, Knoxville, Memphis
Virginia	Arlington, Richmond

FALL WORKSHOPS	
Illinois	Chicago, Rockford
Indiana	Indianapolis
Iowa	Cedar Rapids, Des Moines
Kansas	Wichita
Kentucky	Lexington, Louisville
Massachusetts	Boston, Worcester
Minnesota	Minneapolis
Missouri	Kansas City, St. Louis
Nebraska	Omaha
New Hampshire	Manchester
New York	Albany, Buffalo, Rochester
Ohio	Cincinnati, Cleveland, Dayton
Oklahoma	Oklahoma City, Tulsa
Pennsylvania	Erie
Rhode Island	Providence
Texas	Austin, Corpus Christi, Dallas, Houston, San Antonio
Wisconsin	La Crosse, Madison

Summer Institutes: Data Collection

LabQuest 2 | Computer Data Collection

1 DAY

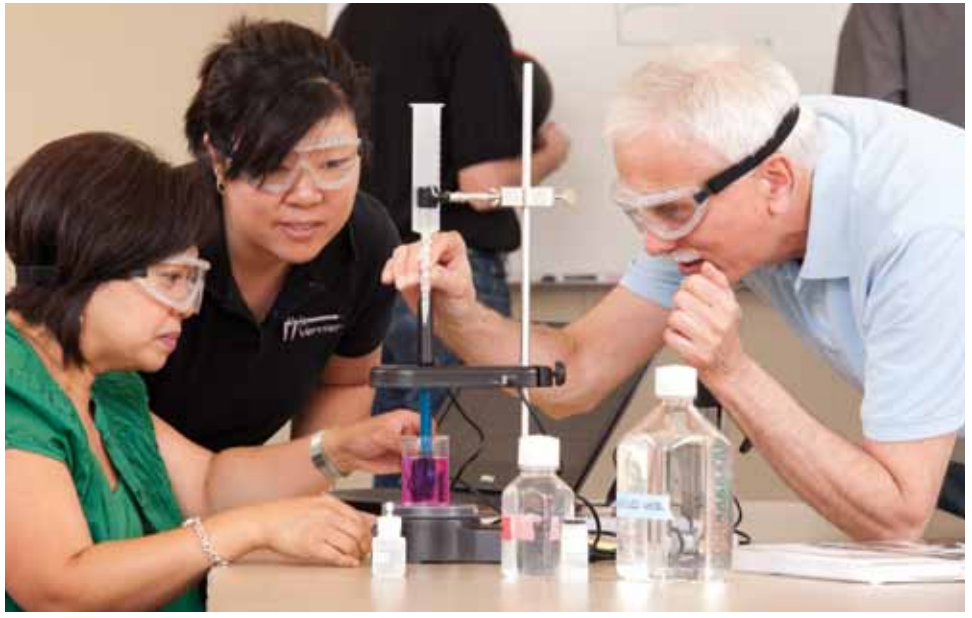
In this six-hour workshop, you will get your hands on dozens of hardware and software titles from Vernier's award-winning line of computer and handheld data-acquisition technology. One of our knowledgeable training specialists will work right alongside you, providing guidance and inspiration as you explore classroom-ready labs.

You'll leave the workshop ready to integrate our data-collection technology into your chemistry, biology, physics, middle school science, physical science, and Earth science curriculum. The $99 registration fee includes lunch, lab handouts on CD, and a lab manual of your choice. Please see the web site for Training Package pricing.

The registration form can be found at **www.vernier.com/summer-workshops**

JUNE	JULY	AUGUST
Atlanta, GA Nashville, TN St. Louis, MO Kansas City, MO Wichita, KS Denver, CO Cheyenne, WY Salt Lake City, UT Phoenix, AZ Albuquerque, NM Amarillo, TX	Houston, TX Dallas, TX Oklahoma City, OK Fairfax County, VA Philadelphia, PA Hartford, CT Pittsburgh, PA Columbus, OH Indianapolis, IN Milwaukee, WI Chicago, IL Detroit, MI	Beaverton, OR Seattle, WA

MORE ONLINE – Information available at **www.vernier.com/training**



FREE Hands-On Training at Conferences

Vernier offers hands-on workshops at each of these conferences. For a full listing of our conference exhibits, check our web site at **www.vernier.com/conferences**

- **Hoosier Association of Science Teachers, Inc,** Indianapolis, IN, February 6–8
- **Michigan Science Teachers Association,** Ypsilanti, MI, March 8–9
- **NSTA National Conference,** San Antonio, TX, April 11–14
- **NSTA STEM Forum & Expo,** St. Louis, MO, May 15–18
- **American Association of Physics Teachers,** Portland, OR, July 13–17
- **ChemEd,** Waterloo, ON, Canada, July 28–August 1
- **NSTA Area Conference,** Portland, OR, October 24–26
- **California Science Teachers Association,** Palm Springs, CA, October 25–27
- **NSTA Area Conference,** Charlotte, NC, November 7–9
- **Conference for the Advancement of Science Teaching,** Houston, TX, November 7–9
- **Virginia Association of Science Teachers,** Norfolk, VA, November 13–16
- **National Association of Biology Teachers,** Atlanta, GA, November 20–23
- **NSTA Area Conference,** Denver, CO, December 12–14

VERNIER WORKSHOP IN PORTLAND

We can conduct a one-day workshop at our office specially designed for you. The workshop can be training only (no charge) or it can include equipment as part of the cost. For information, go to **www.vernier.com/workshops-at-vernier**

VERNIER WORKSHOP AT YOUR SCHOOL

We can come to your school to do a one-day, hands-on workshop using your Vernier equipment. This workshop can be computer or handheld-based data collection, in any science subject. The fee is $1,500, which includes travel expenses (within the continental U.S.). More information and an on-site workshop application can be found on our web site at **www.vernier.com/workshops-at-school**

ADDITIONAL WORKSHOPS

For information on independent workshops that provide instruction in the use of Vernier products, go to **www.vernier.com/training/independent**

WEBINARS

Join us for a free, one-hour training online. Sessions are broadcast live on the web and recorded versions are available for download. Topics include:

- LabQuest 201
- Connected Science System
- Biotechnology: Gel Analysis
- Physics: Video Analysis
- Chemistry: pH Titration
- Biology: Cellular Respiration

For the schedule of upcoming webinars, **www.vernier.com/webinars**

CANADIAN WORKSHOPS

Presented by Merlan Scientific

Let Merlan Scientific customize a Vernier workshop for your school! We know that opportunities for teacher PD are limited, and we can help you make the most efficient use of your valuable time. Request a customized workshop quote today! Contact us at: 1-800-387-2474 | info@merlan.ca | **www.merlan.ca**

PLAN YOUR TRIP TO PORTLAND, OREGON

In 2013, there are two important science educator conferences here in our home town of Portland:

- American Association of Physics Teachers (AAPT) July 13–17, 2013
- National Science Teachers Association (NSTA), Western Area, Oct. 24–26, 2013

Plan your trip to Portland and stop in to see us. We are sponsoring activities at both of these conferences.

GENERAL INFO

Why Choose Vernier?

Products and service that set us apart

Developed by Teachers, for Teachers

We understand the concerns of teachers, and we work hard to make your job easier. Our product development and technical support staff have over 100 years of teaching experience. We understand your concerns because we've been there.

Versatility that Translates into Savings

Vernier gives you more freedom of choice than any other probeware company. We offer state-of-the-art technology with the Vernier LabQuest 2. We offer a wide array of low-cost solutions with our Go! products and our LabQuest Mini. And we offer the Vernier LabPro, which can be used with computers or TI graphing calculators.

Generous Warranty that Lets You Buy with Confidence

Vernier's 5-year warranty on most products gives you a superior level of buying confidence. In fact, in Vernier's 32 years of business, we have rarely charged a customer for a repair, no matter how old the equipment!

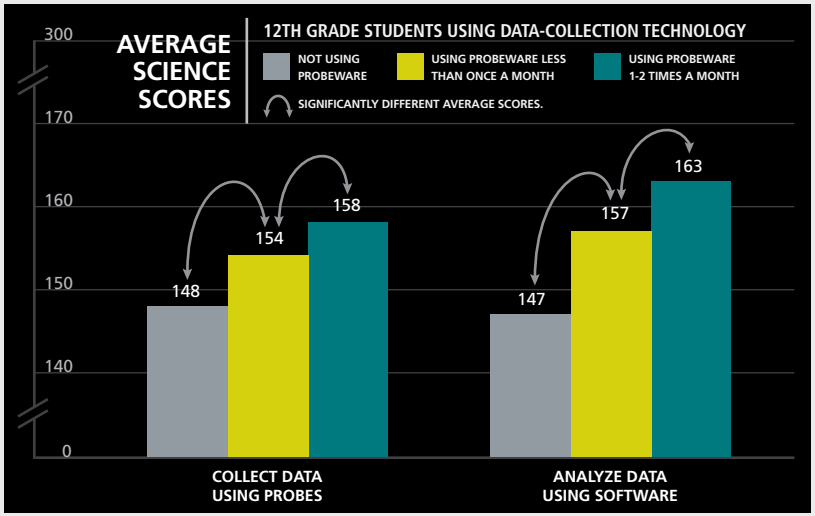
Logger *Pro* 3 Site License Offers Tremendous Value

Purchase our award-winning Logger *Pro* 3 software, and you are entitled to install the program on every computer in your school or college department AND give it to your students to use on their home computers. Excited? There's more.

Logger *Pro* 3 contains all the functions of Graphical Analysis software, including calculator-import and manual-entry data analysis features. That translates into the lowest total cost of software ownership in the education market, with access for every educator and student in your school. No other company offers such a generous site license policy. That's value!

EXTRAORDINARY CUSTOMER SERVICE AND TECHNICAL SUPPORT

When you call Vernier, you'll talk to a former teacher, a lab book author, or a technical expert. You'll speak with people who are passionate about education, science, and helping students succeed. What's the best part? You won't ever talk to sales representatives—just educators and people committed to extraordinary customer service for teachers.



Source: The 2000 NAEP Science Assessment. This study of 49,000 U.S. students shows that students who used probeware to collect and analyze data scored significantly higher on tests than those who did not.

Go to **www.vernier.com/research** for more details

New to Data Collection?

Why Should I Use Data-Collection Technology?

Data collection and analysis helps teachers increase students' critical thinking skills through hands-on learning. Students achieve higher test scores when probeware is included in engaging curricular activities.

Data-collection technology:

- Use of data-collection technology is called for in the *Framework for K-12 Science Education.*
- Frees class time for student engagement in higher-order thinking skills, such as analysis, synthesis, and evaluation.
- Supports STEM education and priorities outlined under ARRA and Race to the Top.
- Enables students to perform many new experiments with measurements not previously obtainable in the classroom.
- Increases test scores in science.
- Is recommended by national organizations, including NSTA, ISTE, ASTE, and IB.
- Encourages inquiry-based lab activities.
- Supports National Science Education Standards.

Request a White Paper on Probeware in Science

Hands-on science using Vernier technology gets students excited about science and deepens their understanding of complex concepts. It gives students the tools to analyze data and think like real scientists. For more on probeware in science, request our white paper at **www.vernier.com/whitepaper**

VERNIER GRANT WRITING GUIDE

Looking to fund a state-of-the art science lab? Vernier has gathered a variety of resources to keep you informed with up-to-date details on available grants and tips for writing a winning grant proposal.

Articles in the Vernier Grant Writing Guide include:

- Working with Your Idea
- Finding a Funding Source
- Writing Your Proposal
- Getting Help
- Supporting Your Idea
- Following Up on Your Grant

This guide will help you write a successful grant proposal and provide you with information on available funding sources.

MORE ONLINE – View available grants and download the Vernier Grant Writing Guide at **www.vernier.com/grants**

"Technology is needed…not just to give students exposure to the technology or to satisfy parents; technology greatly improves learning and supports science education standards that are difficult to teach without using technology."

Metcalf, S. J., & Tinker, R. 2003
TEEMSS: Technology Enhanced Elementary and Middle School Science, *Annual Meeting of the National Association for Research in Science Teaching March 23-26, 2003, Philadelphia*

VERNIER / NSTA TECHNOLOGY AWARD

Award Increased to $5,500 in Prizes for Each Teacher

Full-time science teachers from elementary to college level are eligible to apply for the Vernier Software & Technology/NSTA Technology Award. Vernier will provide up to seven awards, each valued at $5,500, for educators who demonstrate innovative uses of data-collection technology using a computer, graphing calculator, or other handheld device in the science classroom.

The awards will be given to one elementary teacher, two middle school teachers, three high school teachers, and one college-level educator. Each will receive a $1,000 cash award, $3,000 in Vernier equipment, and $1,500 towards travel and expenses to attend NSTA's National Convention in 2014.

Go to **www.vernier.com/grants/nsta/** for guidelines, a grant application, and profiles of previous winners.

Terms and Conditions

VERNIER SITE LICENSE

We have a very generous site license policy. The purchase of one copy of Logger *Pro*, Logger Lite, or Graphical Analysis entitles you to install it on every computer in your school or, for post-secondary institutions, department. Installation to local machines over a network is allowed. Purchasers are also permitted to distribute these programs to their students and instructors for home use. The license is limited to a single campus if your institution has multiple campuses.

OTHER SOFTWARE

NI LabVIEW for Education, Davis WeatherLink, WeatherLink IP for Vantage Pro, ProScope HR software, and software from Texas Instruments are licensed under separate agreements by their respective companies.

TECHNICAL SUPPORT

We are readily available to help you with individual questions about our software and hardware—simply email info@vernier.com or call us on our toll-free number: 888-VERNIER (888-837-6437).

We publish a periodic newsletter, *The Caliper*, with information on upgrades, suggestions for new ways to use our programs, and announcements of new products.

PREVIEW POLICY

Most Vernier products are available for a 30-day preview (or longer, if requested) to educational institutions.

SATISFACTION GUARANTEE

Any product that does not meet your needs may be returned within 30 days for a full refund, subject to the Equipment Return policy stated below. Equipment returned after 30 days may be subject to a restocking fee.

PRODUCT USAGE

Vernier products are designed for educational use. Our products are not designed nor recommended for any industrial, medical, or commercial process such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind. We design our products with the specifications and features that educators and students need to be successful. In our effort to keep our products affordable and easy to use, we may not meet the specifications or include the features that an industrial scientist or medical professional might want.

WARRANTIES

Most Vernier products carry a five-year limited warranty. There are a few exceptions to this warranty for items such as consumables and products manufactured by other companies. These exceptions can be found in each product's manual, our catalog, and on our web site. During the warranty, Vernier will repair or replace the item if there is a defect in materials or workmanship. This warranty does not cover damage to the product caused by abuse or improper use. Outside the warranty, Vernier will attempt to repair the product. In our 32 years, we have rarely charged a customer for repair, no matter how old the equipment!

EQUIPMENT RETURN

A Return Merchandise Authorization, available from Vernier, is required for any product return. Equipment returned for exchange or credit must be in new condition and in its original packaging. Items returned after 30 days of purchase may be subject to a restocking fee.

INTERNATIONAL SALES

Most sales of Vernier products outside the U.S. are handled by:

Vernier International
5026 Calle Minorga, Sarasota, FL 34242
Phone 941-349-1000; Fax 941-349-2766
www.vernier-intl.com | info@vernier-intl.com

Sales in Canada are handled by:

Merlan Scientific
6050 Tomken Rd., Mississauga, ON, Canada L5T 1X8
Phone 905-564-1080; Toll Free 800-387-2474
Fax 800-374-6714; **www.merlan.ca** | info@merlan.ca

PRICES AND SHIPPING

Prices are effective January 1, 2013 and supersede previously published prices. Prices are in U.S. dollars and are F.O.B. Shipping Point. Shipping charges may vary, depending on method of shipment. Prices are subject to change without notice.

PRIVACY POLICY

Vernier Software & Technology does not sell, lease, or loan our mailing list or portions thereof to anyone at any time. We do not store credit card information on our web store or in our accounting system.

If you wish to be removed from our mailing list, simply write to us at info@vernier.com, and we will remove you immediately.

TRADEMARKS

Logger *Pro*, LabQuest, LabPro, SpectroVis, SensorDAQ, Vernier and caliper design, Go!, Go!Link, Go!Temp, Go!Motion, Logger Lite, Connected Science System, Vernier EasyLink, Vernier EasyTemp, and Vernier EasyData are our registered trademarks. Vernier Software & Technology, vernier.com, BlueView, LabQuest Viewer, and Graphical Analysis are our trademarks or trade dress.

Calculator-Based Laboratory, CBL 2, Calculator-Based Ranger, CBR 2, ViewScreen, TI-Presenter, TI Connect, TI Navigator, SmartView, TI-Nspire, TI-Nspire Lab Cradle, Cabri Jr., Teachers Teaching with Technology, MathPrint, and T^3 are trademarks of Texas Instruments.

National Instruments, NI, LabVIEW, and NI LabVIEW for Education are trademarks or trade names of National Instruments Corporation.

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All other marks not owned by us that appear herein are the property of their respective owners, who may or may not be affiliated with, connected to, or sponsored by us.

Vernier has been selling science software and data-collection hardware since 1981. We pride ourselves on the quality and affordability of our products and our service to our customers. If, at any time, you are unhappy with any of our products or service, please call, write, or email.

Vernier Software & Technology
13979 SW Millikan Way, Beaverton, OR 97005-2886
Toll Free: 888-VERNIER (888-837-6437)
Fax: 503.277.2440
www.vernier.com

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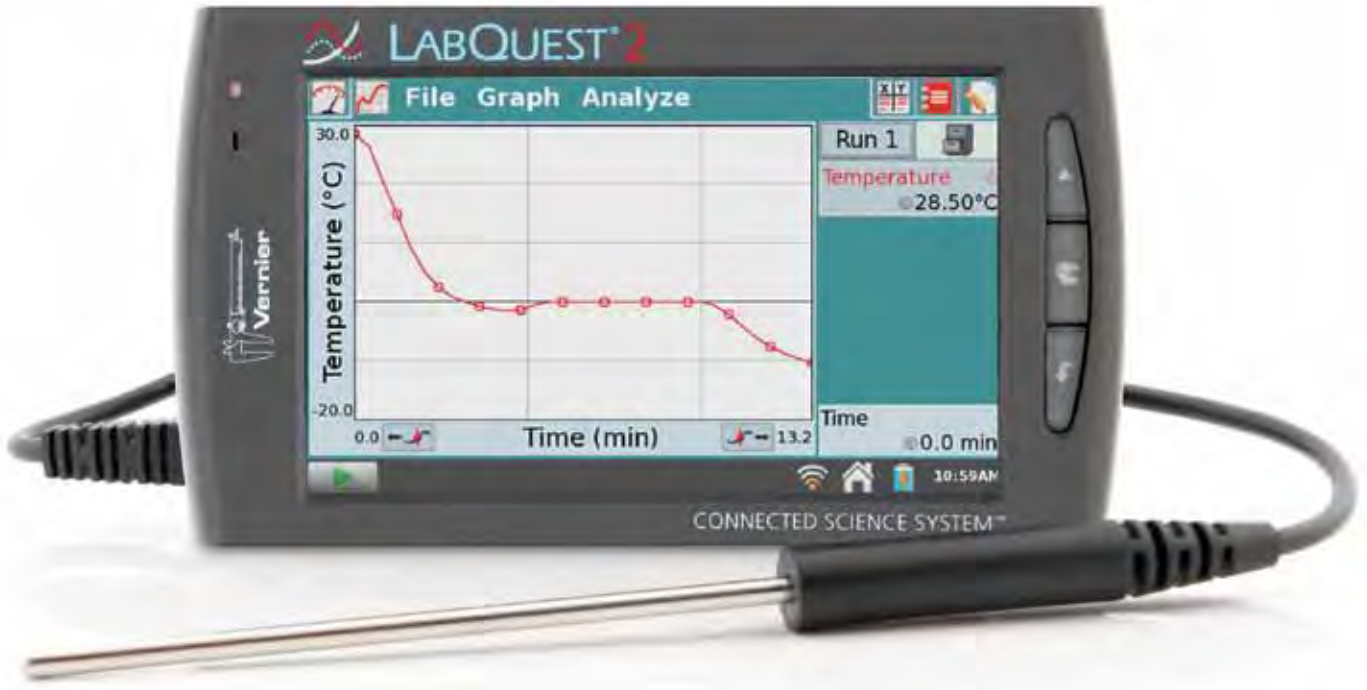

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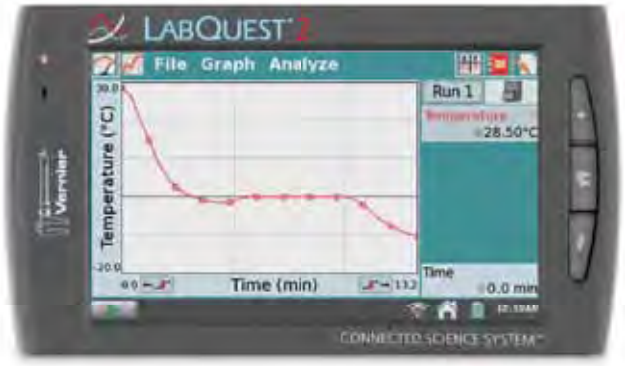

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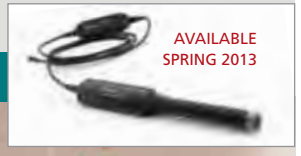

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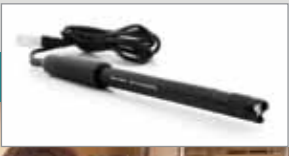

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